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NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.

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How many persons who use electricity in any form appreciate the character of the apparatus which is installed to keep a record of the power which they consume? The electric meter is usually put in by the supply company, and it is generally tucked away out of sight, and, except when the bills come in, it is out of mind. The quality which it must possess is accuracy under all conditions, whether one lamp or fifty is burning, and it must remain accurate without requiring attention. It is doubtful whether there is any other commercial device of which so much is expected. Delicate mechanisms are usually under the care of some one whose business it is to see that they are properly cared for and that they remain in adjustment, but the electric meter must take care of itself. It is sealed up and no one sees it but the man who reads it. In the construction of its parts it is not sufficient to work within the thousandth of an inch, but, when once installed, it must not expect any further attention.

## *SELECTIVE WIRELESS TELEGRAPHY.*

On another page of this issue will be found a description of the wireless telegraph system devised by Mr. John Stone Stone, which is now being operated experimentally from a sending station at Cambridge, Mass., to a receiving station at Lynn.

*Selectivity by Simple Harmonic Electrical Oscillations.*

The feature of the Stone system is that it is an attempt to secure selective signaling by the use of simple harmonic electrical oscillations. The method employed is described in the Stone patents, which were abstracted in the ELECTRICAL REVIEW for December 20, 1902. The practical application of this method was not easy, but the work of Mr. Stone has resulted in the construction of apparatus by which he is able to signal selectively across a difficult piece of country between Cambridge and Lynn, Mass., without being interfered with at all by other electrical disturbances. The selectivity of the system can at present be controlled within ten per cent, but this will no doubt be improved by further work. At present Mr. Stone is working upon selectivity alone, but when a selective system has been brought to a commercial point, it will not be difficult to secure secrecy also. While Mr. Stone's work is not yet completed, he has already made a noteworthy contribution to the art of wireless telegraphy.

## *WESTERN UNION TELEGRAPH COMPANY'S ANNUAL REPORT.*

In his annual report to the stockholders of the Western Union Telegraph Company, at the meeting held on October 14, 1903, Colonel Robert C. Clowry, the president, contributed some remarkable figures to the literature of electrical finances. The telegraph is one of the pioneer adaptations of electricity to commercial service, and beyond improvements in the transmitting devices, the method of operation is the same to-day as it was when the first key was closed. The telephone and all the other forms of commercial adaptations of electricity have had a most remarkable growth, but notwithstanding the facility which the telephone has brought about in the transmission of business communication, it is hard to see wherein it has usurped any part of the telegraph field when we look at such figures as Colonel Clowry has presented in this report. The revenues for the year ended June 30, 1903, were $29,167,686.80, an increase of $1,094,591.70. There was an increase in expense of only $172,448.86, as against an increase in expenses last year, over 1901, of $1,111,863.53. This business was transmitted over 196,517 miles of poles and cables, carrying 1,089,212 miles of wires. The reorganization of the service has also been completed, and the system of thorough inspection, including the Atlantic and Cuba cable terminals, has been continued; and a further reduction of expenses has also been effected. Colonel Clowry is to be congratulated upon his successful administration.

### RELATIVE VALUE OF ILLUMINANTS.

In this issue appears an abstract of the Fourth Progress Report of the Committee for Investigating the Photometric Values of Arc Lamps of the National Electric Light Association. The report in its entirety is especially valuable and voluminous, and copies of it should be sought by all persons who are interested in the subject of illumination.

Since the advent of illumination by electricity, the contest between the electric and the gas lighting interests for supremacy has been unrelenting. By force of circumstances, an amount of information has been accumulated bearing upon the photometric values of arc and incandescent lamps which has placed this branch of electrical application practically on a par with others. The power required, the characteristics and the peculiarities of electric illuminants are so well understood that, by comparison with what is known of other sources of illumination, electrophotometry may be considered an exact science.

The opportunities for variations, inefficient service, and what amounts to failure, in gas lighting are so numerous and so hard to check up as to make it well-nigh impossible to standardize any of the numerous accessories for the utilization of gas as an illuminant, and this is true to such an extent that gas lighting, judged by exact standards, may still be said to be beyond the control of the operator.

*Investigations on the Nernst Lamp.*

Returning to the report, we find it contains a great deal of interesting information bearing upon the Nernst lamp. A review of the findings of the committee brings out the following points: The variations in candle-power of the Nernst lamp for slight variations in voltage are particularly marked. Variations in voltage necessarily involve variations in the current taken by the lamp. The report gives a value of 0.4 ampere per glower as the most satisfactory current to be used from a photometric standpoint.

The report emphasizes the fact that the maximum candle-power emitted by the Nernst lamp occurs directly beneath the lamp and that, when considered in connection with many of the uses to which the illuminant may be put, this distribution is very good, since it provides sufficient upward light for the purposes of general illumination, while the light thrown downward is very strong. For reading tables, counters, machine shop practice, drafting rooms, etc., such a distribution is often valuable.

*Economy of the Nernst Lamp.*

The economy of the Nernst lamp, as given by the committee report, and as based on the mean spherical candle-power of the lamp, does not show this lamp to be much superior to the incandescent bulb.

The tests upon the one-glower lamp show a variation with a clear globe and with an opal globe from 4.11 watts per mean spherical candle-power to 4.91 watts per mean spherical candle-power. In the six-glower lamp an improvement is noted, the consumption being, with clear globe, but 3.3 watts per mean spherical candle-power, and with the opal globe four watts per mean spherical candle-power.

With the Nernst lamp, as with all other lamps, the manner in which the light is equipped has, of course, much to do with the volume of light which is distributed. The committee report shows that, in the case of a three-glower lamp consuming approximately constant power and fitted with nine different commercial equipments, a maximum variation of eighty-four per cent in mean hemispherical candle-power is produced. This is greater than one would believe possible.

The report contains much interesting matter bearing upon the effect of varying the number and arrangement of the glowers in a holder. The whole matter may be summed up by saying that increasing the number of glowers augments the efficiency of the lamp in candle-power per watt, notwithstanding the screening action of the glowers upon one another, owing to the fact that, through mutual radiation, the temperature of the glowers increases with the number of glowers used.

*Comparison of Arc and Nernst Lamps.*

The comparisons which are given between the six-glower Nernst lamp, the 6.6-ampere direct-current series arc, and the 7.5-ampere alternating-current series arc are particularly instructive. Apparently, the arc lamp is superior to the Nernst lamp when considered as a source of illumination for street lighting. The arc lamps give a surface illumination over twice that of the Nernst lamp at a distance of 150 feet from the lamp. This, of course, is owing to the fact, as brought out in Fig. 7, that the maximum candle-power of the Nernst lamp occurs immediately under the lamp, while that of the alternating-current arc lamp occurs at about thirty-eight degrees below the horizontal, and that of the direct-current arc lamp at about twenty-four degrees below the horizontal. The economy for street illumination is therefore greater when the arc lamp is used than it would be if the Nernst lamp were employed; the Nernst lamp always having the advantage over the arc lamp of greater steadiness, or at least of less sharp variations in candle-power under the conditions of ordinary service.

*The Welsbach Mantle.*

Through the information which the report gives of the relative value of the Welsbach mantle and of the flat gas flame, we are given a better insight than we have ever before had of the real value of gas as an illuminant. The committee's report may be taken as the entering wedge which will finally break asunder the vast accumulation of ignorance with which we are dominated at the present time concerning gas lighting. An enormous amount of work must be done before the situation is thoroughly cleared up and before this illuminant can be discussed on its merits in its relation to other illuminants; but progress has been made. We are on a firmer foundation. We are better equipped to attack the problem in the light of truth, and we are sure that this record of performance will greatly stimulate and aid the development of electric lighting.

The report should receive high recommendation from all authoritative sources, and Dr. Matthews and his associates again deserve the thanks of the electrical fraternity for the masterly manner in which the present report treats of the matter presented.

## THE DEPARTMENT OF MACHINERY AND THE POWER PLANT OF THE ST. LOUIS EXPOSITION.

BY THOMAS M. MOORE, CHIEF, DEPARTMENT OF MACHINERY.

Radical departures in all of the great classes of machinery will be illustrated by distinct novelties in Machinery Hall at the Universal Exposition of 1904. Gas engines of great power, steam turbines, enormous machine tools, automatic machinery, practical elimination of the line shaft and pulleys and the substitution of directly connected motor in machine shop practice, high pressures and superheated steam in engine and boiler practice, the generation of gas for distinctly power purposes will perhaps constitute the newest and to the engineer the most interesting and instructive features; but the great standards and the standbys which have been evolved by the master minds of the engineering world will not be lost sight of or ignored. The machinery department has been fortunate enough to engage the cooperation and active, cordial and hearty support of the machinery industries both at home and abroad.

It has been possible to arrange for the collection here of the greatest power plant that the world has ever seen, and further, to assemble a collection of machinery for making machinery which will adequately picture the condition of that most important industry. The offerings have been so many and so notable as to necessitate a very careful selection of the exhibits for which space will be allotted. There is a motive, a harmony, a picture present in exposition work quite as much as in the art of the musician or painter or sculptor, and he who merely collects a heterogeneous mass of exhibits, however worthy individually, yet without relation or sequence or logic, fails. And so, in the machinery department the effort has been not so much to gather together a collection, as to gather together a collection of masterpieces, each representing the best thought in each particular line of endeavor, yet each having its relation to the other elements and the total making a complete, coherent, effective and instructive picture. It is hoped that this motive will live in history in contradistinction to the remembrances of the machinery departments in former expositions, where the recollection of only one or two great items has survived.

In the foreground and centrally located, the great power plant of the exposition will properly claim the first attention. This remarkable collection will include a total of about 50,000 horsepower in steam and gas engines and will occupy the entire westerly half of Machinery Hall, or an area of something over 200,000 square feet, about the size of an ordinary city block. There will be installed on this space three great lines of prime movers. The northern line will consist of steam engines exhibited by the foremost builders in England, France, Sweden and Germany, as well as by the great establishments of this country. The southern line will consist of gas and oil engines. The central line between these two will be made up of mammoth steam and gas engines. It would be erroneous to consider any one of these lines as more important than either of the other two, but the character of Machinery Hall renders it necessary to install the highest and most massive engine units in the central bay of the building. Each line is 100 feet wide and about 600 feet long and each will be full of engines in operation.

The great gas engine from the works of John Cockerill, of Seraing, Belgium, will cover an area eighty-two feet long by forty-three feet wide. This engine with its electric generator weighs over 400 tons; it has five times the power of any gas engine ever exhibited in any exposition; it has three times the power of any gas engine on the Western Hemisphere, and twice the power of any gas engine operating in Europe, and it is fifty per cent greater than any gas engine ever designed and now in process of construction. It will exemplify the highest type and the greatest might yet seen, or likely for many years to be seen, in the development of the gas engine. It introduces a new factor for consideration in the planning of great railway and lighting power plants.

Another new factor is the steam turbine or steam turbo-generator. This illustrates the long-sought but until very recently never realized, the rotary steam engine. The largest engine of this type will be one of 3,000 horse-power, from the General Electric Company, of Schenectady. It has the advantage of being extremely economical in the space required for its installation and operation, very inexpensive foundations and remarkable efficiency. It is stated that orders for engines to a total of over 500,000 horse-power are now held in abeyance, pending the determination of the practical success of the steam turbine. From this it should not be understood that turbo-generating sets are still in the experimental stage, for nothing of unproven worth or efficiency will be shown in our exposition power plant, but investors like to see what they are to pay for—to see is to believe—and not one person in half a million has ever seen a high-power steam turbine in operation.

In reciprocating steam engines the most powerful shown will be from the Allis-Chalmers Company, of Milwaukee and Chicago. This is a vertical and horizontal compound engine of the type which furnishes power for the Manhattan Elevated Railway, in New York. The engine to be exhibited here towers over thirty-five feet above the floor level, it covers about 1,700 square feet of floor space, and with its generator (built by the Bullock Electric Manufacturing Company, of Cincinnati) it weighs over 600 tons, that is, thirty average car loads.

Each of the engines in the power plant will be directly connected to its electric generator; for the distribution of energy throughout the entire exposition will be electrical and all artificial light, all cascade or fountain work, and all motion wherever found in the exposition will have its source in the power plant in Machinery Hall and the Steam, Gas and Fuels Building which is an annex to Machinery Hall.

A noteworthy feature of the power plant installation will be the illustration of the elimination of space by the exactness of method and expression which now obtains among engineers the world over. Taking one installation for example, one element is being built in San Francisco, Cal., another in Jeanesville, Pa., another in Ampere, N. J., another in Providence, R. I., and still another in Boston, Mass. Still the five will be assembled here and, without question, they will all fit the one to the other and operate as if built in one shop. The same is true of another installation; one element of which is being constructed in Seraing, Belgium, another in Manchester, England, a third in Schenectady, N. Y., and a fourth in Milwaukee, Wis. For the most part it is improbable that any one of these engineers has ever seen any one of the others. Certainly, no builder of one part has seen the progress of the work on the other parts, yet engineering has become such an exact science both in itself and in its expression that the perfect operation of the complete machine when assembled can not be reasonably questioned.

The Steam, Gas and Fuels Building, which covers an area of about 100,000 square feet, is in effect an annex to Machinery Hall. In this building will be found great hoppers for storing the 4,000 tons reserve supply of coal and mechanical means for automatically conveying this coal from the cars to the bunkers and from the bunkers to the furnaces and gas plants. The daily consumption of coal will exceed 400 tons, and the total length of the automatic conveyor lines will be about three-quarters of a mile. Boilers, gas producers, briquette machines, various types of mechanical stokers, forced draft apparatus, water purifiers, and exhibits of items directly germane to the subject of steam generation and control will be installed in this building.

## SHOP TESTING FOR COMMERCIAL SERVICE—III.

BY BERTRAND B. ABRY.

### THE DIRECT-CURRENT SHUNT AND COMPOUND MOTOR.

The usual tests made on shunt and compound motors are practically the same and the results obtained and the curves plotted therefrom are in general similar, with one exception, namely, the speed curve of the two motors. The shunt motor is essentially a constant-speed motor, whereas the speed of the compound motor varies with the load.

In this article the shunt motor will be considered in particular, and the compound motor noted where the difference in the calculations and the curves are marked.

The following are the usual tests and calculations made:

1. Speed test.
2. Iron loss and saturation, and friction tests.
3. Brake test.
4. Efficiency calculated from the losses.
5. Temperature test.
6. Insulation test.

1. Speed Test—In making a speed test on a shunt motor, a convenient method is to belt-connect the motor to a generator of a slightly greater capacity. This allows overload speeds to be obtained if desired. Another method sometimes used is to rig the motor with a Prony brake and vary the load and the speed in that way. Using a generator as load, the observations made on the motor are as follows:

| Speed. | Voltage. | Armature Amperes. | Field Amperes. | Total Amperes. |
|---|---|---|---|---|
| | | | | |

It is usual to begin the test at full load or a slight overload according to the test requirements. When the test is started adjust the generator field and load until the motor is giving its full load, or the desired overload output. Hold the voltage and motor field current constant, and begin taking observations. Note the speed and observe the reading of the instruments at the same time. The total amperes are of course the sum of the motor armature amperes and field amperes, and are simply calculated for each set of readings. After taking the first set of readings, cut down the load; that is, the motor armature amperes. This is done by changing the load on the generator. Continue these readings until no load conditions are reached. Throw the belt off, remove the pulley, and take a final set of readings, being careful, however, that the motor field current is not reduced.

Together with the speed curve of the shunt motor, the field ampere curve is usually plotted. In these tests this will naturally be a straight line.

Plot the speed and field ampere curves on a total or external ampere base; that is, the sum of the armature amperes and field current. Fig. 7[1] shows the general shape of such curves for both shunt and compound motors.

Although a shunt motor is considered a constant-speed motor, there is always this slight variation in speed from no load to full load, as shown by the curve. This gradual decrease in the speed may be accounted for as follows:

In varying the load over the range desired for making a speed test, the drop in the armature increases from a minimum at no load to a maximum at full load or overload. With a constant field the effect is equivalent to reducing the impressed voltage. By keeping the impressed voltage constant, and gradually decreasing the field as the load is increased, this drop might be entirely compensated for and a constant speed obtained for all loads. But as the drop in speed is not excessive, it is customary to make the speed test with a constant field.

It should be stated in this connection that the position of the brushes also affects the speed. Much depends upon the design of the machine, but in general, with sufficient back lead, an increasing speed with an increasing load may be obtained. On the other hand, a decreasing speed with an increasing load results, even to a more marked degree than shown on the curve, when the brushes are given a forward lead.

It may also be noted that it is possible to get an increasing speed with an increasing load due to armature reaction alone, which may be sufficiently great to weaken the field.

2. Iron Loss and Saturation and Friction Tests—The method of making these tests has already been explained under the direct-current generator. In this case the motor is run as a generator, belt-connected to another motor. The same observations are made and the curve plotted in a similar manner.

3. Brake Test—This test provides a convenient method for determining the efficiency of any machine by measuring the torque and the kilowatt input and output. Any convenient form of brake, such as the Prony brake, may be used.

The following data are observed and calculated:

| Volts. | Arm. Amps. | Field Amps. | Total Amps. | Speed. | Observed Torque. | Torque at One-Foot Radius. |
|---|---|---|---|---|---|---|
| | | | | | | |

From these results the total amperes are calculated and the observed torque reduced to pounds torque at one foot radius after first making allowance for the tare. In a test of this kind it is usually quite difficult to obtain accurate speed readings. If a satisfactory speed test has been made previous to the brake test, it is not necessary to note the speed during this test, since it may be obtained from Fig. 7 for the several corresponding total amperes. From the above observed data plot accurately in pencil a preliminary curve of speed and torque, using total amperes as abscissæ as shown in Fig. 8. In motor calculations we use total amperes because the efficiency varies with the total energy put into the machine. That is to say, a certain amount of power is delivered to the motor from the line, part to the armature and part to the field, and we obtain a certain torque at the pulley after supplying the losses. From the ratio of output and input we obtain the efficiency, as will be shown later.

From this preliminary plot of the speed and torque select even values (for convenience only) of the amperes and note the corresponding values of the torque and speed. Tabulate as follows:

| Volts. | Amperes. | Speed. | Torque. | B. H.-P. | E. H.-P. | Efficiency. |
|---|---|---|---|---|---|---|
| | | | | | | |

Knowing the speed and torque, the brake-horse-power may be computed from the following formula:

Brake horse-power = speed × torque × $\frac{2\pi}{33000}$ where torque equals pounds pull at one-foot radius. For convenience the above equation may be written

[1] These curves, Figs. 7, 8 and 9, are not plotted from the performance of any particular motor but are merely intended to show the general shape and relation of such curves.

Brake horse-power = speed × torque × 0.0001904.

The electrical-horse-power equals of course total amperes multiplied by volts and divided by 746; that is,

$$\text{Electrical horse-power} = \frac{\text{watts input}}{746.}$$

The electrical horse-power represents the input to the motor and the brake-horse-power the output, hence the ratio of the output to the input gives the efficiency.

The characteristic curves of a shunt or compound motor are plotted from these results. They take the general form shown in Fig. 9.

4. Efficiency Calculated from the Losses —This method of obtaining the efficiency is sometimes used to check the efficiency obtained from the brake test.

The cold resistance should be measured and then increased such an amount as will correspond to the average temperature at which the motor will probably run in service. This was explained fully under the direct-current generator. When this

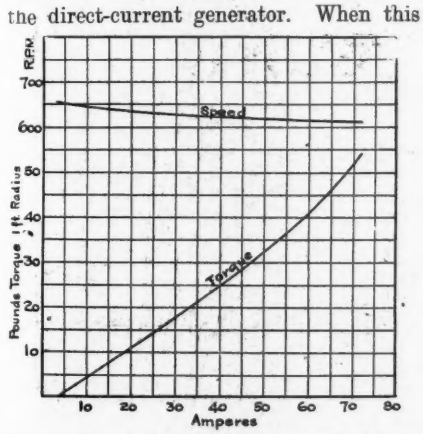



FIG. 7.—SPEED CURVES SHUNT AND COMPOUND MOTORS.

has been done a speed curve should be taken noting the following:

| Speed. | Volts. | Armature Amperes. | Field Amperes. | Total Amperes. |
|---|---|---|---|---|
| | | | | |

Observe also no load readings on the neutral point. The column of total amperes is calculated. Make a preliminary plot of speed and field current with total amperes as base. Then as before, take even values of amperes and read off corresponding values of the speed and field current. Tabulate as follows:

Calculate the different columns beginning with "armature amperes" which is equal to total amperes minus field amperes.

The $C^2R$ armature loss = (armature amperes)$^2$ × corrected armature resistance.

If a compound motor, the corrected series field resistance must be included.

The $C^2R$ shunt field and rheostat loss = volts × field amperes.

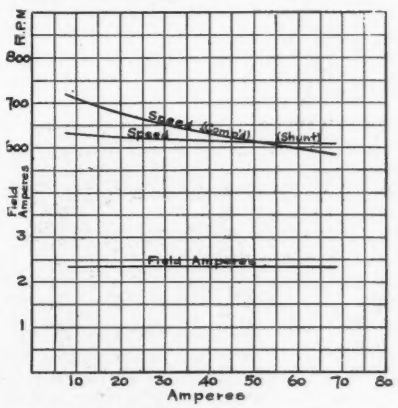



FIG. 8.—PRELIMINARY PLOT OF SPEED AND TORQUE.

As in the case of generators the $C^2R$ brush loss is calculated from the brush cross-section and the total amperes flowing. That is, for a certain number of amperes per square inch, there will be a certain average drop, as explained under direct-current generators. The product

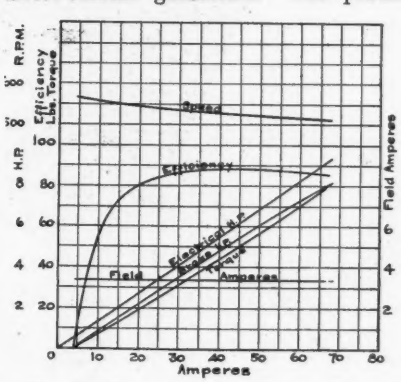



FIG. 9.—CHARACTERISTIC CURVES SHUNT MOTOR.

of the drop and the total amperes gives the watts lost in the brushes.

The iron loss, brush friction loss, and the friction and windage loss may be computed from the no load readings as observed in the speed test. That is, these losses will equal the total no load watts (watts in armature and field) minus no load field loss.

Adding all these losses gives the total loss in the machine, which should be noted in the "total loss" column.

Watts input = total amperes × volts at terminals of machine.

Watts output = watts input — losses.

And as before, the efficiency = output/input.

The torque for different loads may be calculated from the brake-horse-power formula, where

$$\text{Torque} = \text{B. H.-P.} \times 33{,}000/2\pi \times \text{R.P.M.}$$
$$= \text{B. H.-P.} \times 5{,}252/\text{R. P. M.}$$
$$= \text{watts output} \times 7.04/\text{R. P. M.}$$

The efficiency calculated in this manner from the losses should check with the efficiency as obtained from the brake test.

5. Temperature Test—The temperature test on a motor is similar to a generator temperature run and is made to determine the temperature rise of various parts after a certain length of run at a predetermined load.

6. Insulating Tests—The insulation tests on these motors are carried out in a manner similar to the generator insulation tests, but varying only between 1,500 to 3,000 volts alternating current.

| Volts. | Total Amperes. | Field Amperes. | Armature Amperes. | $C^2R$ Armature and Series. | $C^2R$ Shunt and Rheostat. | $C^2R$ Brushes. | Iron Loss, Brush Friction, Friction and Windage. | Total Loss. | Watts Input. | Watts Output. | Efficiency. | Horse-power Input. | Horse-power Output. | Speed. | Torque. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |

## *Foundry Exhibit at St. Louis Exposition.*

President Engler, of the Worcester Polytechnic Institute, recently had a conference with a number of leading foundrymen from different parts of the country respecting the building and exhibit which the latter purposes to have at the St. Louis Exposition. It is proposed to erect and operate a model foundry, fully equipped with all necessary apparatus and exhibiting in operation all the processes of modern foundry practice. An advisory committee has been appointed to organize the work, and of this committee President Engler is a member. The Worcester Polytechnic Institute has been invited to prepare complete plans for the building, having in mind special reference to ideal conditions as to light, heat, ventilation and sanitation, and to a maximum of economy and efficiency by convenience of arrangement and use of the best modern devices in machinery and methods. Besides furnishing space for all ordinary operations in iron, brass, aluminum, steel and lead, the building is to provide accommodations for a chemical laboratory, an exhibition room, a library and reading room, etc. This foundry exhibit is designed to be primarily educational in its character, and during the entire time while it is in operation at St. Louis it will be under the direction and charge of the Worcester Polytechnic Institute.

# The Home Telephone Company, Dayton, Ohio.

*A Description of the Large Automatic Exchange Recently Inaugurated.*

THE automatic telephone exchange built for the Home Telephone Company, of Dayton, Ohio, by the Automatic Electric Company, of Chicago,

EXCHANGE BUILDING, HOME TELEPHONE COMPANY.

Ill., having a present installation for 6,000 stations and an ultimate capacity of 19,000, began service early in July. The five-story building in which the exchange is located is at the corner of Fourth and Jefferson streets, in the centre of the

FIG. 1.—WALL SET.

city, and occupies an area of forty-nine feet by 104 feet. The lower three floors are rented for stores and offices; the fourth floor contains the offices for the Home Telephone Company and of the United States Telephone Company, and the terminal room in which the distributing rack, the power plant, wire chief, and the information and trouble clerks are located. The fifth floor is one big hall without columns and contains the automatic switchboards and a repair room. The equipment is the Strowger automatic system, and the method of calling may be given in a few words. There are now in operation 2,000 telephones, and the balance are being rapidly connected up.

Suppose subscriber 2378 wants to call 5712, he takes receiver from hook, puts his finger in hole No. 5 on the dial of his telephone, as shown in Fig. 1, pulls it to the finger stop and lets it return to normal position. He then repeats the same motion, using consecutively the holes 7, 1 and 2, and at last he presses the push-button, thus ringing subscriber No. 5712. If telephone No. 5712 is busy the calling party will hear in the receiver a buzzing sound. When a conversation is ended the hanging up of the receiver restores all connecting apparatus to the normal position.

The subscriber's set is either a wall telephone, Fig. 1, or a desk telephone, Fig. 2. The wall telephone is a well finished box which contains the calling and talking apparatus, the ringer and the local battery, which consists of two dry cells. The desk set contains only the transmitter, induction coil, and the calling device, while the ringer and local battery are placed at any convenient point. The desk set is a nickel-plated, polished apparatus,

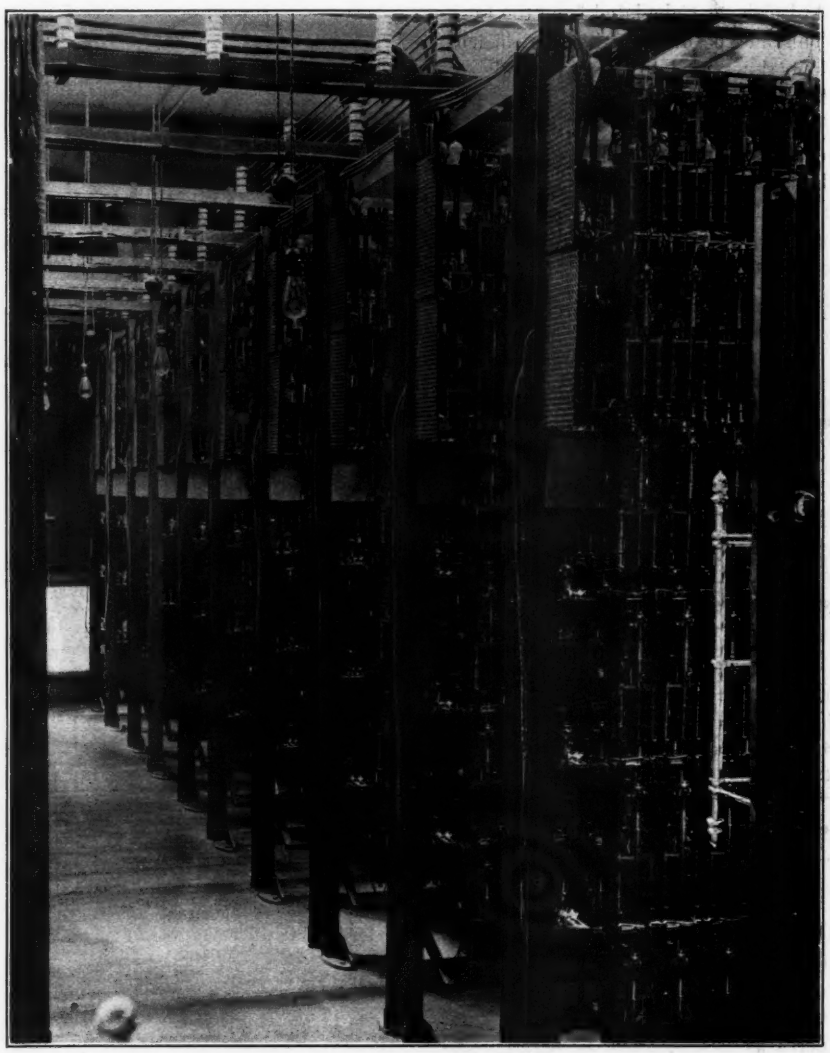


FIG. 4.—GROUP OF TEN SWITCHBOARDS, REPRESENTING 100 SUBSCRIBERS.

the weight of which is approximately seven pounds complete.

Each subscriber is connected to the exchange by two lines which end in what is called a first selector switch, Fig. 3. This first selector consists of a couple of relays; a vertically and rotatably movable shaft which bears at its lower half three wipers and three contact banks. The contacts in these banks are arranged in three rows, of ten contacts to the row, mounted in semi-circular form. The upper bank is the "busy" bank and the two lower ones the "line" banks. The above-mentioned shaft coincides with the geometrical axis of the banks, and the wipers are adapted to connect to the contacts, one wiper for each bank. The subscriber's operation of rotating the dial with the finger in the fifth hole will lift the shaft, and with it the wipers, to the fifth row of the bank contacts. These contacts are connected by cables to group "five thousand" in the exchange, and the wiper automatically connects with one of these contacts which is not busy. At this point the mechanical part of the first selector switches off. The above-mentioned cable ends in a second selector, an apparatus almost like the first selector. The subscriber's second operation, with the finger in the seventh hole of the dial, raises the shaft of the second selector to the seventh row of the contacts and connects with one of the contacts in that row which is not busy. These bank contacts are connected by another cable to the seventh hundred of the fifth thousand group, and the cable ends in what is called a connector. The connector differs from the selector in being adapted to respond to the last two operations of the calling subscriber, *viz.*, the tens are called by lifting the shaft of the connector, and the units by rotating the same, so that the rotating of the dial with the finger in No. 1 will lift the connector shaft to the first row of bank contacts and the movement using No. 2 rotates the shaft to the second contact of the first row. From these contacts two wires lead to the line of subscriber No. 5712.

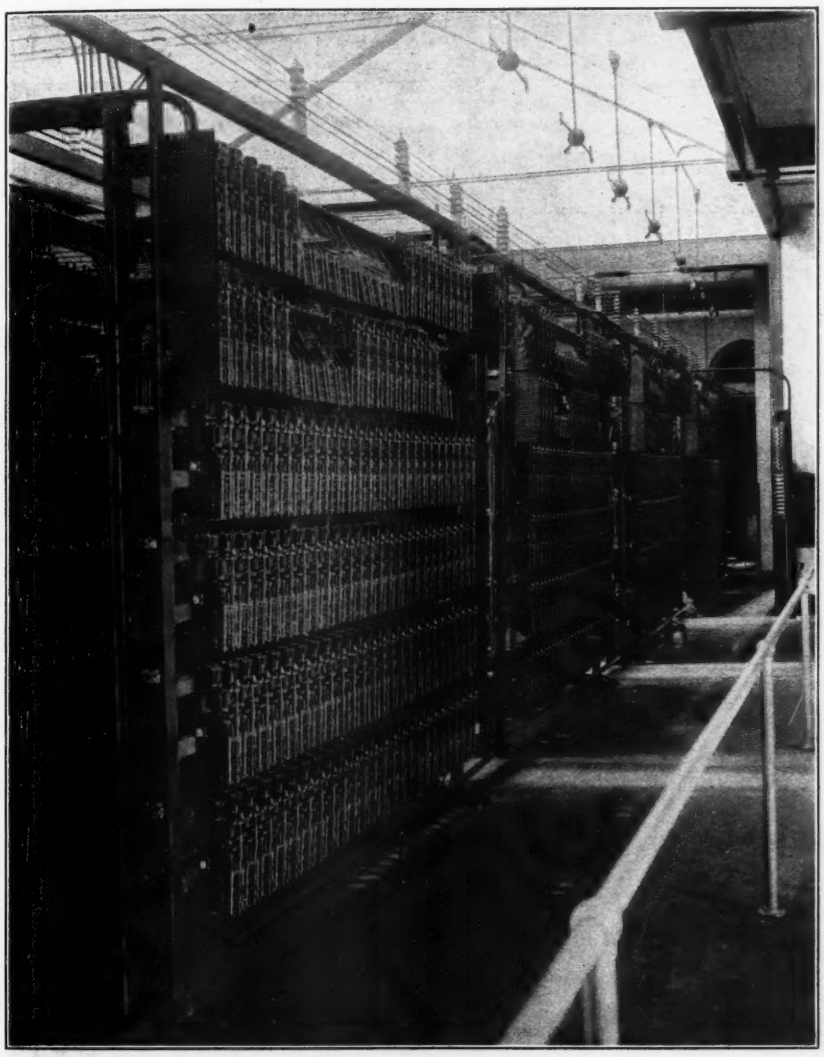


FIG. 5.—VIEW ALONG THE FRONT OF SWITCHBOARDS, SHOWING FIRST SELECTOR, SECOND SELECTOR AND CONNECTOR TERMINALS.

FIG. 2.—DESK SET.

Suppose that subscriber No. 2379 wants to call No. 5713, he can not use the same set of bank contacts and cable wires from first to second selector and connector, since No. 2378 occupies these lines already. He must therefore use lines that are not engaged. The first selector of

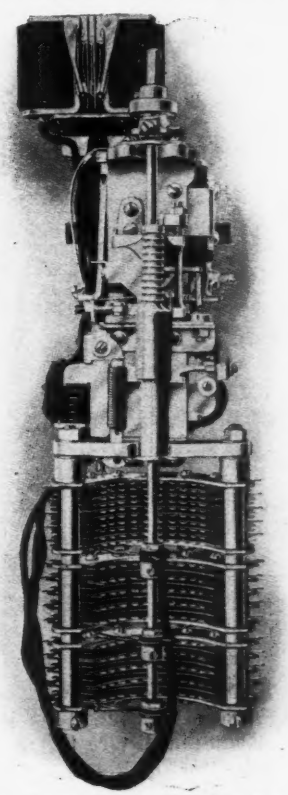


FIG. 3.—FRONT VIEW, SELECTOR SWITCH.

No. 2379 will automatically rotate to the second contact, or the first which is not in service in the fifth row of bank contacts, thus connecting with another second selector and another connector which

are free. It will be seen that the wipers, banks and connecting cables correspond to the cords in the manual board, and that the selectors select in each case an idle cord. The ringing is done by a ringing relay on the connector. Suppose (in the first case referred to) that subscriber No. 5712 is busy. As soon as the connector wiper worked by No. 2378 strikes the busy connector contact the connector is released even before the dial of 2378 has completed its back motion, and a battery current thrown on the calling subscriber's line gives him the busy signal. It is impossible to cut in on a busy line. As long as the two subscribers talk together nobody can disturb them. If the called subscriber desires to disconnect himself from the calling party he may do so by rotating his dial once and hanging up the receiver; so that nobody can maliciously occupy the line of anybody else. In order to be able to restore each switch to its normal position one part of it must remain connected to the talking lines.

In former plants each switch possessed two relays of very low resistance which were cut in series with the lines, *i. e.*, one had to talk through them. Though the transmission of the voice was excellent, the system was changed to a so-called bridging system, in which each switch has two relays of one thousand ohms together, connected across the two lines, so that the talking line is an uninterrupted metallic circuit with no self-induction besides that of the line itself. To voice currents having a high frequence the high-wound relays are entirely impenetrable. In Dayton the bridging system was used for the first time on a large scale.

Looking at the accompanying switchboard illustrations it will be noticed that the switches are mounted on frames made of angle iron. Each frame or so-called switchboard is ten feet five inches long, and eight feet nine inches high. A switchboard consists of six shelves. Each first selector is directly connected to a separate line so that each switchboard represents 100 subscribers. The top shelf has fifteen second selector switches and the second shelf has fifteen connector switches. Any switch can be taken off without disturbing the others and without disconnecting a wire, and if necessary may be replaced by another one. Ten boards are arranged (Fig. 4), the one behind the other forming a group of one thousand first selectors, with requisite second selectors and connectors, and six of these groups form the whole exchange of six thousand lines. It may be mentioned that each thousand group can be completed by itself and be taken into service independently of all other thousand groups. In the Dayton exchange four groups were used while the last two groups were in course of erection. And just as easily extensions to the present equipment may be made without disturbing the service of the working groups. As there are fifteen connectors for each one hundred subscribers, or to each switchboard, it will

FIG. 6.—GENERAL VIEW OF SWITCHBOARD ROOM.

be seen that fifteen calls can be made into a board, and fifteen calls can be sent out at the same time, thus allowing thirty switches of each one hundred to be in use at the same time. This percentage of thirty can easily be increased by simply filling the empty spaces on the second selector and connector shelves, the two shelves at the top of each board (Figs. 5 and 6). The ultimate capacity of the Dayton board is twenty-five calls into each one hundred, and at the same time twenty-five calls out of each one hundred, a percentage which will never be required.

Looking at the illustration, Fig. 5, three cable terminals will be noticed on each board. The one on the right side at the

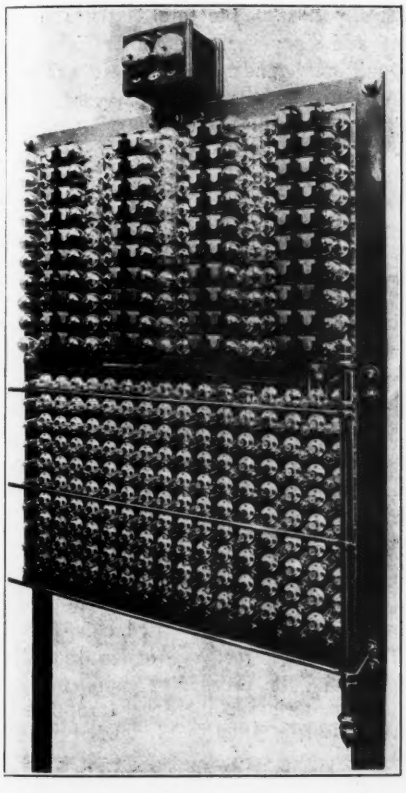


FIG. 7.—TELL-TALE BOARD.

top is the terminal used for the first selectors. The top one on the left side is the second selector terminal and the one underneath is the connector terminal. The cables leading from the first selectors to the connectors run along the side of the board (Fig. 4); the cables from the second selectors to the connectors run from board to board backward at the top of the boards, and the cables from the connectors to the lines are seen inside of the left side post. The lines come to the board through the floor from the distributing rack, located on the fourth floor. The distributing rack does not possess any features differing from those used in manual telephone exchanges. It was built by Frank B. Cook, of Chicago, and is equipped for 6,000 lines.

The outside construction of the plant is

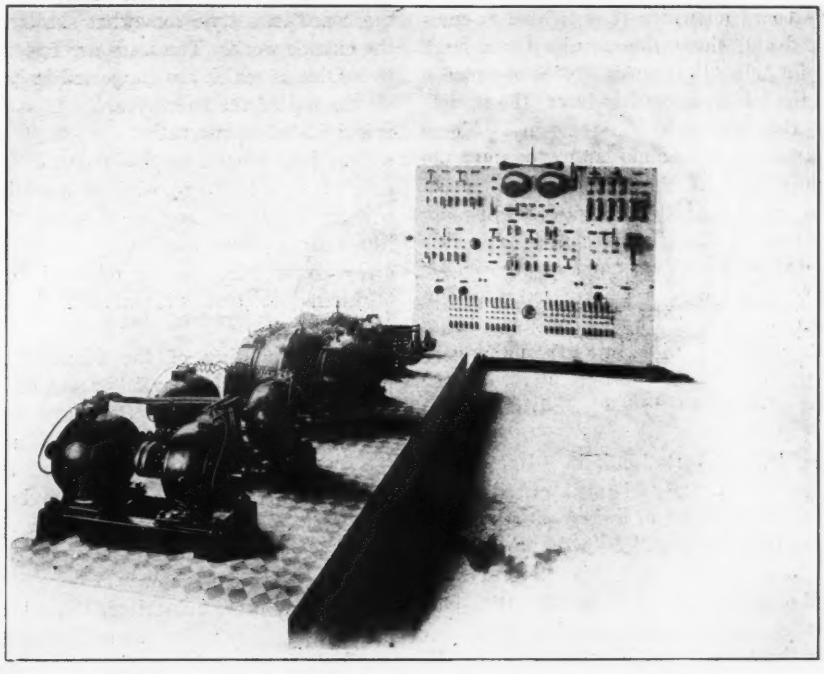


FIG. 8.—POWER BOARD, GENERATOR AND INTERRUPTER MACHINES.

as perfect as it can be made. In the business district two hundred pairs of lead-covered cables are laid in fifteen miles of underground conduits. Branches are brought to poles situated in alleys whence every telephone can be reached by an unsupported drop. Outside of the business district aerial cables are strung, the longest being four miles. The lead cover is used as "ground." The lines enter the exchange by passing through a heat coil which is mounted on the switchboard on the back of each switch.

Over each strip of the distributing rack

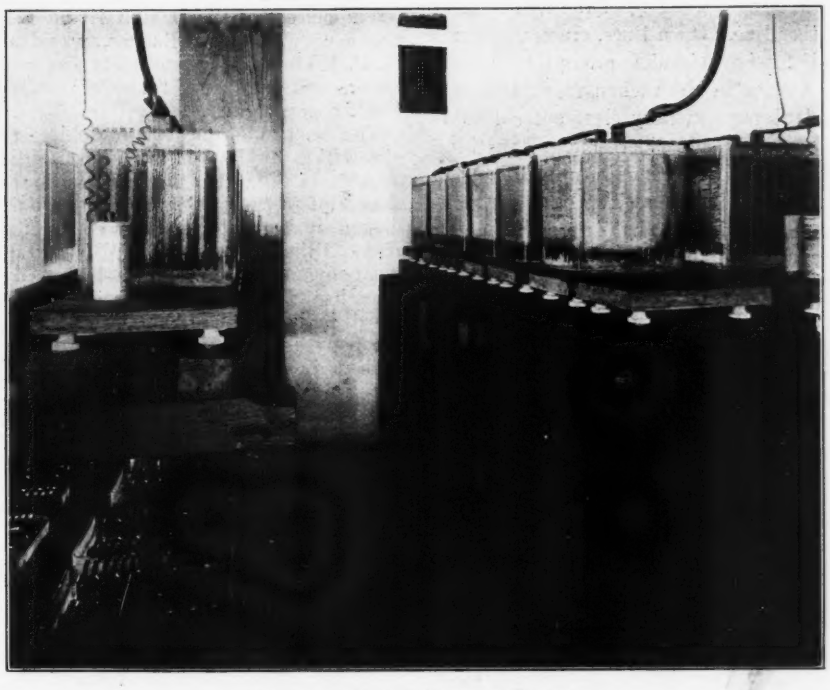


FIG. 9.—STORAGE BATTERY PLANT.

a small lamp is lighted as soon as the heat coil breaks down, indicating immediately where the trouble is located. From each switchboard a so-called tell-tale cir-

cuit leads to a relay on the tell-tale board, as shown in Fig. 7. This tell-tale board is made of slate, mounted on an iron frame. Whenever a heat coil blows, instantaneously the relay corresponding to the board on which it is located is energized and closes the circuits for a lamp and a bell. It is possible with one glance at the tell-tale board to locate the trouble by the lamp which is glowing. These tell-tale relays and lamps occupy the upper half of the tell-tale board. On the lower half the generator lamps are mounted. The ringing generator is connected to nickel bus-bars. There is for each switchboard a pair of lamps and a separate pair of wires. Should a call go into a short-circuited line the ringing generator will not be short-circuited, but the generator lamps flash up and indicate to the attendant at once where to look for trouble. A short-circuit in a line will so show up in the exchange. If the subscriber at the end of a short-circuited line tries to make a call he will not get the desired number, but his first selector makes an unusual noise and the attendant can at once find out what has happened. Another trouble which may arise in the outside construction is a ground. That shows up in the exchange by blowing the heat coil on the back of the switchboard and ringing the tell-tale bell. An "open" in one of the lines will indicate itself by the improper working of the first selector in that line. Open lines, crosses, grounds and foreign circuits promptly indicate themselves in the exchanges, and the attendant can generally clear out a trouble before the subscriber knows anything about it. It is sometimes necessary to find out which subscriber has called another subscriber. That is easily done by means of small pilot lamps on the back of the switchboard. As soon as a switch is lifted off its normal position the lamp at the end of the shelf lights up. These lamps are arranged so that they can be seen from any place in the exchange. As a help to follow a call small blue-prints are affixed to the board, which diagrammatically show the circuits.

The power to operate the switches is delivered by two storage batteries of twenty-six cells, built by the American Battery Company, Chicago, having 400 ampere-hour capacity each. The batteries are charged by two motor-generators, which are supplied with current from the electric light circuit at 220 volts. Besides the generators the power platform contains three ringing generators and two interrupter machines.

The power board, Fig. 8, has three panels of marble and holds all the necessary measuring, switching and protecting apparatus. The different kinds of current are brought to the fifth floor in iron conduits, and are distributed on top of the board in a style somewhat similar to the outside work. The leads are fastened to insulators which are supported by pins on the top of the switchboard. It was a principle of construction to have all wiring done as open as possible, so that in case of trouble every wire is accessible without disturbing any other wire. The illustrations show how every cable and every power wire can be followed from beginning to end without lifting any cover.

In the building of the Home Telephone Company the Dayton branch of the United States Telephone Company is located. This company has long-distance lines all over the state of Ohio, and already has connections with Cleveland, St. Louis and other important places. If a subscriber wants long-distance he calls the long-distance operator who has a number like any other subscriber. The long-distance operator makes manually the toll connection, as it is usually done, and plugs the subscriber to the toll line. In the case of incoming calls the operator makes the connection through her toll board, calling and ringing the subscriber with the automatic instrument affixed to the toll board.

The officers of the Dayton Home Telephone are: John T. Barlow, president; H. C. Kiefaber, vice-president; James C. Reber, secretary and treasurer; R. D. Funkhouser, cashier.

The telephone world is watching the installation at Dayton with keenest interest. It was the first automatic exchange of so great a capacity to be built, though it was closely followed by that of the Illinois Telephone and Telegraph Company, of Chicago. The latter company has a ten-thousand station switchboard built by the Automatic Electric Company and is now connecting up subscribers in that city. More than 1,500 stations are already in operation, and a large number are being added each day. The automatic exchange of five thousand stations in Grand Rapids, Mich., is expected to be in complete operation within sixty days, and the exchange which is now being installed for the Northeastern Telephone Company, Portland, Me., with an initial installation of twenty-five hundred stations will be in operation within forty days.

### *The Production of Rubber.*

The importations of india-rubber into the United States last year amounted to more than 50,000,000 pounds, with a value of over $30,000,000. In 1890 the quantity was only 33,000,000 pounds; in 1880, 16,000,000 pounds, and in 1870, 9,000,000 pounds. In 1862, the earliest date at which it was separately shown in the import statements, the quantity was 2,125,561 pounds.

The rapid growth in the demand for india-rubber in manufactures has brought about a new industry which is novel in its extent and in its requirements. This has been the reclaiming of india-rubber scrap. During the past few years there have been from ten to twenty million pounds per year of "old and scrap rubber fit only for remanufacture." The industry of importing and reclaiming india-rubber for use in manufacturing utilizes large quantities of worn-out rubber boots and shoes and other articles of this character. In 1893 the total importation of old and scrap india-rubber was less than a million pounds. In 1896 it was over 3,000,000 pounds; in 1898, more than 9,000,000 pounds; in 1900, 19,000,000 pounds and in 1902, 22,000,000. In 1903, the total was 24,659,394 pounds, valued at $1,516,137. This is outside of the scrap secured in the United States.

A new product has recently been developed which may be utilized in conjunction with india-rubber. This is gutta-joolatong. It is a product of the East Indies, chiefly the island of Borneo, and the following description of it, taken from the report of the Bureau of Statistics of the Department of Commerce and Labor, states that it is "whitish in color, looking something like marshmallow candy, smelling strongly of petroleum and oxidizing on exposure to the air, becoming hard. It is not a substitute for gutta-percha or india-rubber, but is used chiefly as a filler in manufactures of india-rubber gum and gutta-percha." The importation of this material has increased from 6,500,000 pounds in 1899 to 14,000,000 pounds in 1903.

A large proportion of the india-rubber imported into the United States is produced in Brazil, over one-half of the total amount coming from that point. Considerable quantities come from the United Kingdom, presumably the product of her colonies, and from Belgium, principally the product of the Congo Free State, which is under the control of the Belgian Government and its industries of this character controlled by the people of that country. Recent reports received by the Division of Consular Reports of the Bureau of Statistics have shown the entire practicability of producing the best Para rubber in territory immediately adjacent to the Philippines, from trees transplanted from South America, suggesting the possibility that the Philippine Islands may in time supply at least a part of the growing rubber consumption of the United States.

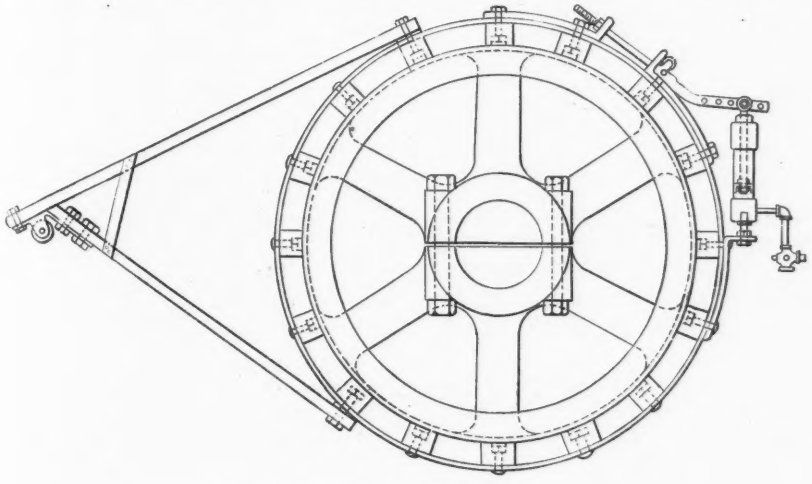
### A PRONY BRAKE CONTROLLER.

BY JAMES H. TAYLOR.

When the adjustment of a Prony is made, as is generally the case, by means of a screw turned either by a wrench or a hand wheel, it is difficult to keep the load constant. Variations in temperature or in the amount of lubrication applied to the wheel produce such great changes in the friction between the wheel and the brake as to cause sudden fluctuations in the load.

The accompanying figure illustrates an improved arrangement devised by the author which eliminates, he believes, much of this trouble and maintains a constant load for any period of time desired.

Referring to the sketch, the pulley is surrounded by a strap brake of the usual type and provided with the necessary arms for transmitting the pull to the measuring device. The tension on the brake is regulated by means of a lever which itself is operated by air, steam or water pressure acting upon a piston which moves within the cylinder as shown. This cylinder is made from a piece of three-inch pipe with an ordinary coupling at each end. The bottom is plugged to make it tight, and to the side, near the bottom, is attached a three-eighth-inch pipe through which the operating fluid is admitted. In this pipe, and placed at some point convenient to the man in charge, is the operating valve. This is of the ordinary type, with a five-sixteenth-inch hole drilled at right angles to the port through the plug and side of the case, so as to release the pressure in the cylinder when the valve is given a quarter turn.



PRONY BRAKE CONTROLLER.

The piston of the cylinder is made of leather, and the pressure is transmitted from the piston to the brake band by means of a cam and a short lever of adjustable length. The apparatus allows the load to be applied to the engine instantaneously, or as gradually as may be desired, and the dimensions given are suitable for absorbing from 5 to 350 indicated-horse-power. The controlling valve can be placed near the engine throttle, so that one man has entire charge of the engine. The brake is, of course, suitable for testing any other motor, and it has been used by the author for making engine tests at the Ames Iron Works, Oswego, N. Y., for some time past.

### The World's Production of Petroleum in 1902.

In his report to the United States Geological Survey on the production of petroleum in 1902, now in press, Mr. F. H. Oliphant gives the following table showing approximately the production of crude petroleum in all the known countries of the world, together with the percentages of each for 1902, in terms of United States barrels. A small estimated quantity is placed under the head of "all other countries," included in which is the primitive production in several of the South American states, and in Algeria, Persia, the Philippines, and China, from which no returns could be secured.

The total increase in 1902 amounted to almost seven per cent as compared with 1901, and to almost twenty per cent as compared with 1900. The most conspicuous items in the list are the increase in the production of the United States and the decrease in the production of Russia, the result being that the output of these two countries reached nearly the same figures in 1902. In 1902 the United States and Russia produced 91.08 per cent of the total output, as compared with 93.22 per cent in 1901 and with 94.11 per cent in 1900. Of the remaining 8.92 per cent produced by all other countries, Sumatra, Java, Borneo, Galicia, and Roumania, which furnished only 4.65 per cent in 1901, furnished 6.82 per cent in 1902, leaving 2.10 per cent of the total as the output of the other producing countries.

WORLD'S PRODUCTION OF CRUDE PETROLEUM IN 1902.

(BARRELS OF FORTY-TWO UNITED STATES GALLONS.)

| Country. | Quantity. (Barrels.) | Percentage of Total. |
|---|---|---|
| United States | 80,894,590 | 45.64 |
| Canada | 520,000 | .29 |
| Peru | 60,000 | .03 |
| Russia | 80,540,045 | 45.44 |
| Galicia | 4,142,160 | 2.35 |
| Sumatra, Java, Borneo | 5,860,000 | 3 31 |
| Roumania | 2,059,980 | 1.16 |
| India | 1,570,500 | .89 |
| Japan | 1,193,000 | .67 |
| Germany | 353,675 | .20 |
| Italy | 12,000 | .02 |
| All other Countries | 26,000 | |
| Total | 177,231,900 | 100.00 |

In 1898, 1899, 1900 and 1901 the production in Russia exceeded that in the United States; but in 1902, by its gain of 11,505,396 barrels and by the decrease of 4,628,511 barrels in Russia as compared with 1901, the United States more than made up its deficiency and exceeded Russia's production, for the first time in five years by 354,545 barrels.

Although in the production of crude petroleum the United States and Russia so closely divided the 91.08 per cent of the entire production of the world in 1902, yet when the quality of the crude petroleum is considered, the parallel is by no means so complete, since more than double the quantity of the higher grades of refined products was obtained from the average crude petroleum produced in the United States as compared with that produced in Russia. Out of a gross output of 80,894,590 barrels of crude petroleum, the United States obtained approximately 1,766,737,000 gallons of refined products, or about sixty-seven per cent; Russia, out of a gross production of 80,540,045 barrels, obtained refined products to the extent of 676,536,000 gallons, or about twenty-six per cent; and the remaining countries of the world obtained from their crude production about seven per cent of the total output of refined products. Thus it appears that in 1902 the United States produced a little more than two barrels of refined products for every barrel produced by the rest of the world.

The purest and most valuable grades of crude petroleum in the known world continue to be produced in the northeastern portion of the United States—in the Appalachian and the Lima-Indiana fields. A very fair grade of crude petroleum is also produced, though in comparitively small quantities, in Sumatra, Java, Galicia, Roumania and India.

## THE ELECTRIC TRAMWAYS OF KALGOORLIE, WESTERN AUSTRALIA.

BY S. W. CHILDS.[1]

In many respects, the continent of Australia offers opportunities for the investment of American capital, energy and brains unsurpassed by few other countries in the world. This is particularly true of the state of Western Australia, occupying the western portion of the island continent. This section comprises an area of nearly 1,000,000 square miles, much of which is yet undeveloped, but which has large mining, agricultural and industrial possibilities.

A description of the Kalgoorlie electric tramways will suffice to show, as a single instance, what has been and what can be accomplished in the transportation line alone. Although the city of Kalgoorlie is situated 400 miles inland from Perth, the nearest seacoast town, this city now enjoys the facilities of an electric tramway system, built and operated according to the latest American practice, and not surpassed, as far as engineering features are concerned, by any city of similar size in the old or new world.

Kalgoorlie has a population of about 30,000 people and the tramway lines were laid out to furnish transportation within the city itself and to the gold fields lying in the outskirts of the city. The heaviest business handled by the tramway comes from the miners who flock to the city in large crowds, particularly on Saturdays and Sundays. The tramway system comprises sixteen miles of track, of which ten miles are double-track and six miles are single-track lines. The fares are collected on the "flat" system; that is, the fare is threepence, or six cents, for a ride within the municipal boundaries, and sixpence, or twelve cents, to any point outside the city or into the Roadsboard district, as the suburbs are called. Cash fares are collected and registered as in the United States.

The tracks are laid in a soil which is practically a good natural cement of ironstone composition, which, though hard to work, forms a very good and permanent road-bed. In some cases, excavations for track were made by native laborers with pick and shovel, and in some cases with horse-drawn plows. The rail is a ninety-pound girder, supplied partly by a Belgian house and partly by the Lorain Steel Company, of the United States. For ballast and road-making, residue from the gold mines, known as "blue metal," was used to good advantage. This is harder than granite and, when broken into sizes ranging from one and one-half to two and one-half inches in diameter and laid to a depth of six inches under the ties, forms a very hard and firm, yet elastic road-bed. The rails are laid on ties of "jarrah" wood, a native wood as hard and fine as American mahogany. This wood is practically indestructible and is absolutely proof against the attacks of the white ants and impervious to moisture. This is the wood that is now being used with great success as block paving in the streets of London. The ties are six by eight inches by seven feet six inches, laid two feet centres. The rails are joined with six-bolt fish-plates, with tie rods every six feet. The track is bonded with Mayer & Englund double bonds under the fish-plates. It is interesting to know that during the track excavation work, gold nuggets were frequently turned to the surface by the plow—unfortunately, however, not in paying quantities.

For double-track lines, the double-bracket style of overhead construction was employed with a single line of thirty-five-foot poles of "jarrah" wood between the tracks. The overhead brackets were supplied by the Mayer & Englund Company, of Philadelphia. On single-track lines single-bracket construction was used.

The car house measures 300 by 60 feet, and is equal to anything to be found of similar size in the United States. It is built of steel throughout, covered with galvanized iron. The steel for the building was furnished by the American Bridge Company. The pit arrangement at the car house is novel and is applicable to American conditions. The track rails upon which the cars rest in the car house are carried on cast-iron columns five inches in diameter, resting upon concrete cement piers. There is no flooring, strictly speaking, in the car barn, but all the work is done from the ground level, as will be understood from the illustrations. To expedite repair work, a bogie truck with flat-tired wheels is used, which can be moved about at will over the ground level. At the back of the barn on the lower level is a set of cross tracks so that armatures and truck and motor parts can be dropped to this level and taken under the cars to any part of the workshops on the bogie trucks. The workmen stand on the bogies when doing the truck and motor-repair work.

Owing to the scarcity of fresh water in this locality, there have been constructed at the car barn two concrete cement tanks running the full width of the building into which is drained all the rain water falling upon the roof. These tanks are sixty feet long, eight feet deep and five feet wide, and each year they catch and render available about $5,000 worth of water, which is used for washing the cars and for fire-protection purposes. The car house is equipped with a complete system of automatic sprinklers in the roof, the water for the sprinkling system being drawn from the cement storage tanks by a pump and forced to an elevated tank near the car house by which means adequate pressure is maintained on the sprinkling system.

The company owns ten double-truck cars and fifteen single-truck cars, all of which are of the closed type and were furnished by the J. G. Brill Company, of Philadelphia. The cars are mounted on Brill trucks, and in the case of the single-truck bodies they are equipped with two G. E.-58 motors. The double-truck cars have four G. E.-58 motors to each car, following accepted American practice.

Power is furnished by the Kalgoorlie Electric Power and Lighting Corporation, Limited, which also supplies electric power to the neighboring gold mines. This power plant is capable of producing power economically, using during dry seasons water which is practically a saturated solution of ordinary and other salts. The entire plant was designed by J. G. White & Company, Limited, of London, and this company later secured the contract for its complete construction, and built a plant which is generally recognized as being unusually well built. The power-house contains three vertical units, each consisting of an 800-horse-power Stewart engine, made by D. Stewart & Company, of London and Glasgow, and direct-connected to a 500-kilowatt General Electric alternator. These units supply two-cycle alternating current at 600 volts, which for tramway purposes is changed to 550 direct current in two General Electric rotary converters, located at the power-house. Steam is furnished by a battery of Babcock & Wilcox boilers, using "Australian gum" wood as fuel.

Up to a short time ago practically the only water available for power-house purposes was a brackish water obtained from the low levels of the mines, and to fit this for boiler purposes it was necessary to maintain large evaporating and condensing plants. Lately, however, the Kalgoorlie water system has been completed,

[1] Formerly general manager of the Kalgoorlie Electric Tramways Company.

which is now pumping fresh river water from the coast, 400 miles away.

The Kalgoorlie electric tramways are owned by a London syndicate, but were built by J. G. White & Company, of New York and London. The tramways were opened to the public on May 20, 1902, and on the opening day souvenir tickets were sold for fifty cents each, at which price over 10,000 tickets were sold to people who were anxious to commemorate the event by riding on the opening day.

One of the difficulties in the way of economical operation is the climate, which is very dry for nine months in the year, these conditions giving rise to severe dust-storms, the dust in the air at times becoming as thick as the proverbial London fog. Under these conditions it is difficult to maintain the exterior and interior finish of the cars in good condition, and the dust also hinders operation by filling in the groove of the rail. The only way of freeing the groove from this accumulation of dust is to force it out by a stream of water, fed under pressure to nozzles attached to the sprinkling cars. As before stated, the water contains a large percentage of salt and this is not conducive to long life of rails or motor equipments. The top soil is also saline and very hard on the rails.

Although the cost of building these tramways was very high, due to the transportation and tariff charges, it is interesting to know that the road was built at a cost of $5,000 per mile less than the original estimate. The cost of living in Australia is high, and labor is able to demand high wages. Ordinary laborers on the track receive one shilling and threepence, or thirty cents, an hour, and conductors and motormen are paid $3 a day, of eight hours.

The grade crossing idea has reached into the centre of Australia, one instance being the "Golden Gate Crossing at Kalgoorlie, where a crossing at grade was overcome by building an overhead bridge, consisting of steel girder floor beams, resting upon concrete cement abutments.

## *THE TELEPHONE EXHIBIT AT THE CINCINNATI FALL FESTIVAL.*

BY J. E. PEAVEY.

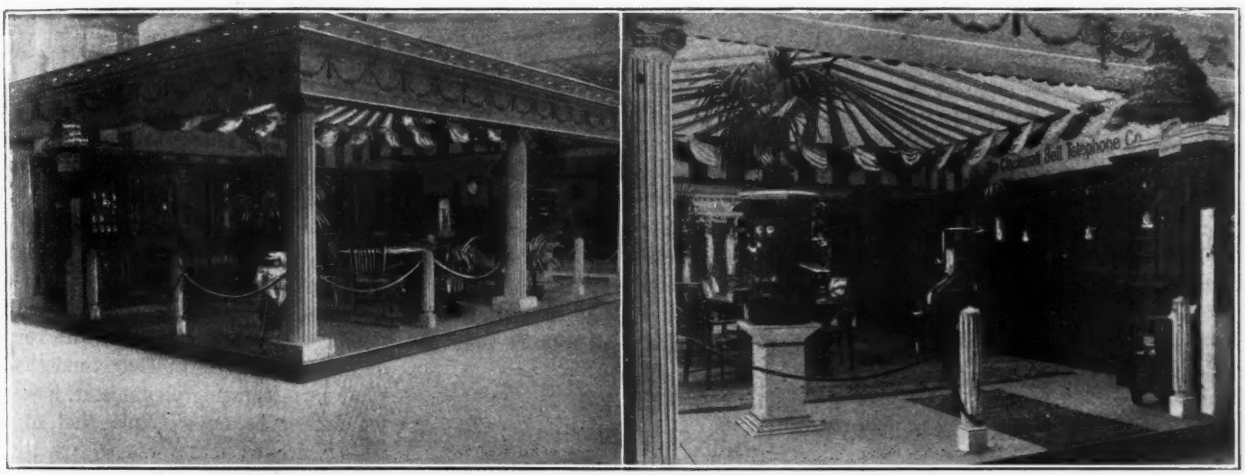
A most interesting exhibit was made by the Cincinnati Bell Telephone Company at the fourth annual fall festival recently held at Cincinnati, Ohio. The accompanying illustrations, Figs. 1 and 2, give a general and interior view, respectively, of the Cincinnati Bell Telephone Company's booth. Here were located the switchboard for handling the various telephone connections throughout the festival grounds, telephone booths for those desiring to call up parties outside of Cincinnati, and a comfortable lounging quarters for visitors and guests.

As an additional feature of attraction there was a neat showboard displaying the various types of instruments furnished to the subscribers, and also a facsimile of the first telephone ever shown to or used by the public at the Philadelphia Centennial in 1876.

On each side of the exhibit booth were two telephones mounted on apparatus so that they could be used by parties standing in the aisles and out of sight of each other. These two instruments were connected together and so arranged that one party could look the other in the eyes while talking to him. This feature furnished considerable amusement to large crowds every day during the show.

Two large blue bells with loud-talking telephone receivers were hung over each aisle. During the band concerts these bells played the music brought over by wire as it was rendered by the band in another part of the exposition.

The Telephone company has always taken a liberal part in these festivals, not only in furnishing a fine display, but by putting telephones in all of the exhibitors' booths, where wanted, and giving free service throughout the grounds. As an adjunct and means to facilitate the handling of large crowds the telephone has no equal, as it connected up the police department, the emergency hospital, the president's offices, the information bureau, the fire department and all of the ticket offices at the entrance gates.




FIGS. 1 AND 2.—THE TELEPHONE EXHIBIT AT THE CINCINNATI FALL FESTIVAL.

## *Air Friction.*

Mr. W. Odell related some interesting experiments at the recent Southport meeting of the British Association for the Advancement of Science, in his paper entitled "Preliminary Experiments on Air Friction." These experiments were begun with the object of finding a convenient method of determining the power wasted by the windage of flywheels and dynamo armatures. The experiments were made with paper discs mounted on the shaft of an electric motor. The excitation was kept constant, so that the torque was proportional to the current. Thus the extra current required to maintain a given speed after the disc had been fixed to the shaft gave the torque absorbed by the disc. There was found to be an angular speed for each decrease above which the torque was proportional to about the 2.5th power of the speed. This critical speed appeared to vary inversely as the square of the diameter. Below it the law followed was of a lower degree. However, owing to the multiplication of errors in measurements, no definite conclusion as to its exact nature was arrived at. As the three discs originally tried gave uncertain results as to the effect of size, a much larger one—nearly four feet in diameter—was tried. As a result of all the experiments it was concluded that the torque varied as about the 5.5th power of the diameter. The author stated that a disc of forty-seven inches required 0.1 horse-power to keep up a constant speed of 500 revolutions per minute, and that if a different law held, a nine-foot disc would absorb ten horse-power at the same speed.

## NATIONAL ELECTRIC LIGHT ASSOCIATION.

### THE FOURTH PROGRESS REPORT OF THE COMMITTEE FOR INVESTIGATING THE PHOTOMETRIC VALUES OF ARC LAMPS.

[*Abstract.*]

The committee has received, from time to time, requests for measurements made upon sources other than the arc lamp. Realizing the importance of comparative results, the committee has, during the past year, authorized tests upon several light sources now in common use, these tests to be conducted in the same laboratories, and with the same care and rigor that have characterized its previous work. More particularly, the sources tested during the past year have been the Nernst lamp, the mantle burner of the Welsbach type, and the open gas flame.

The report of Dr. C. P. Matthews and his assistants, Messrs. Paul G. Winter and Terry T. King, who have conducted the work during the past year, is divided as follows:

(1) Tests of the Nernst lamp.
(2) Tests of the mantle gas burner.
(3) Tests of the naked gas flame.
(4) A consideration of the illumination derived from these sources.

The work has been carried on in the electrical and photometric laboratories of Purdue University, as heretofore. For the work on gas sources, a special laboratory has been equipped with the necessary photometric apparatus, meters and pressure regulators.

A careful series of tests has been conducted upon the Nernst lamp, of the one, three and six-glower types, equipped with the various globes, shades and heater cases furnished by the manufacturers.

In making candle-power measurements on the Nernst lamp, constancy of voltage is of the utmost importance. A special test given in the report shows that a change of one per cent in the voltage makes in this particular case a change of more than fourteen per cent in candle-power. It was found that operation of the Nernst lamp under conditions of a constant current of 0.4 ampere per glower gives the most satisfactory result from a photometric standpoint.

Fig. 1 shows the distribution of candle-power from a six-glower lamp in a horizontal plane containing the glowers. It will be seen that the candle-power in this plane varies between wide limits. Normal to the glowers the value is 260 per cent of that parallel to the glowers. This horizontal distribution of candle-power is characteristic of the parallel arrangement of glowers in a horizontal plane. It is interesting to contrast this curve with similar curves obtained from the naked gas flame, the mantle burner and the arc lamp. These last-named sources give candle-power distributions in the horizontal plane that are circular, or nearly so. When the Nernst lamp is equipped with a diffusing globe, its horizontal distribution of candle-power is, of course, considerably rounded out. Because of this peculiar distribution of candle-power, the computation of the mean spherical intensity presents some difficulties not found in the case of the other sources referred to. The difficulties are, in fact, precisely those encountered in spherical measurements on an incandescent lamp. In table 1, the relative errors in the three different methods of computing the mean spherical intensity from candle-power distribution are shown. The methods are: (1) from the mean of six distribution curves in vertical planes fifteen degrees apart; (2) from the mean of two distribution curves, namely, parallel and normal to the glowers; (3) from a single distribution curve in a vertical plane thirty-five degrees to the glowers.

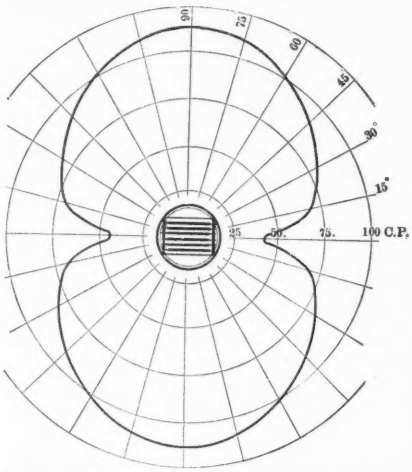



FIG. 1.—HORIZONTAL DISTRIBUTION OF CANDLE-POWER ABOUT SIX-GLOWER LAMP, EQUIPPED WITH CLEAR GLOBE.

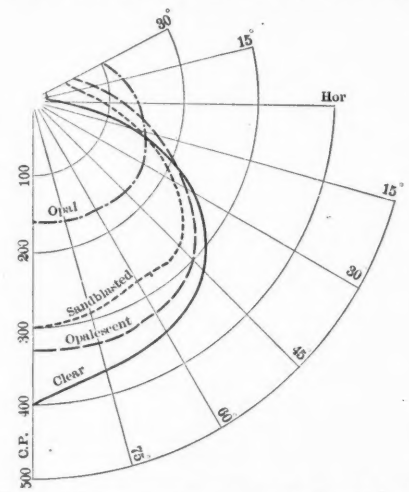



FIG. 2.—DISTRIBUTION OF CANDLE-POWER IN A PLANE PARALLEL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH GLOBES AS INDICATED.

TABLE 1.

ERRORS IN COMPUTATION OF MEAN SPHERICAL AND MEAN HEMISPHERICAL CANDLE-POWER.

| Lamp. | Mean of Six Curves Every Fifteen Degrees around Glowers. | Mean of Parallel and Normal. | Thirty-five Degrees to Glowers. |
|---|---|---|---|
| | Per Cent Error. | Per Cent Error. | Per Cent Error. |
| Six-glower, clear globe, M.H.S. | 0 | −4.3 | |
| Six-glower, clear globe, M.S. | 0 | −4.0 | |
| Six-glower, pearl opal globe, M.H.S. | 0 | −0.8 | −2 |
| Six-glower, pearl opal globe, M.S. | 0 | +1.8 | −1 |
| Three-glower, pearl opal globe, M.H.S. | 0 | +0.5 | |
| Three-glower, pearl opal globe, M.S. | 0 | +0.9 | |

Considering the first method as correct, the errors in the other two methods are as tabulated. The second method seems to yield a result correct to about one per cent when diffusing globes are used, and about four per cent when clear globes are used. It was found that there is no single plane, in which a candle-power distribution can be taken and integrated for the mean spherical intensity, with correct results for all types of globes and shades. With an integrating photometer, however, the matter becomes simply that of the taking five or six photometer settings, the mean of which yields the value sought.

From the records of the many Nernst lamp tests, contained in the report, those on a six-glower lamp equipped with various globes and shades are reproduced here as being fairly typical. Figs. 2 and 3 show the distribution of candle-power from this lamp in vertical planes, respectively parallel and normal, to the glowers.

Figs. 4 and 5 show candle-power distribution in the same planes from the same lamp when equipped with opal and metal shades. The results show that the Nernst lamp equipped as indicated gives maximum candle-power directly beneath the lamp. It may be said that for many purposes this distribution of light is very satisfactory, there being sufficient upward light for the purposes of general illumination, while the light thrown downward within an angle of forty-five degrees from the vertical is very strong, making a desirable source for the illumination of reading tables, counters, machines, etc. A comparison of Figs. 2 and 3 brings out

the great difference in the distribution of candle-power in the two vertical planes, respectively parallel and normal, to the glowers, to which reference has already been made. The use of opal and sand-blasted globes alters the distribution of candle-power in such a way as to diminish the downward intensities and increase the outward and upward intensities.

The marked effect of various shades and globes on the downward flux of light is well illustrated in the case of the tests upon the three-glower Nernst lamp. As tested with a constant current of 0.4 ampere per glower, this lamp consumes approximately 260 watts. It yields mean hemispherical candle-power ranging from 64.3 for the pearl opal ball to 118.4 for

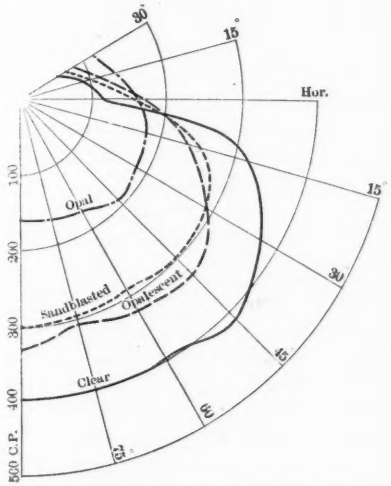



FIG. 3.—DISTRIBUTION OF CANDLE-POWER IN A PLANE NORMAL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH GLOBES AS INDICATED.

the clear heater case. The corresponding values of watts per mean hemispherical candle-power being 4.18 and 2.22.

The wide variation in these values indicates clearly how it is possible to alter the flux of light below the horizontal plane by the use of different globes and shades, and is a strong argument against the rating of lamps on the basis of mean hemispherical candle-power, or, for that matter, on any basis that does not take into account the total volume of light emitted by the source. Coming now to a comparison of the light output, based on the mean spherical candle-power, we find a minimum of 51.9 and a maximum of 68.7, the power consumption being the same as in the previous case. The corresponding variation in specific power consumption or watts per mean spherical candle-power is from 5.09 to 3.84. It is evident that the variation in mean spherical candle-power can be due only to differences in the absorbing power of the globes and shades used. To put the matter in another way, this three-glower lamp, consuming approximately a constant power, is made to yield through the agency of its nine different equipments a maximum variation of eighty-four per

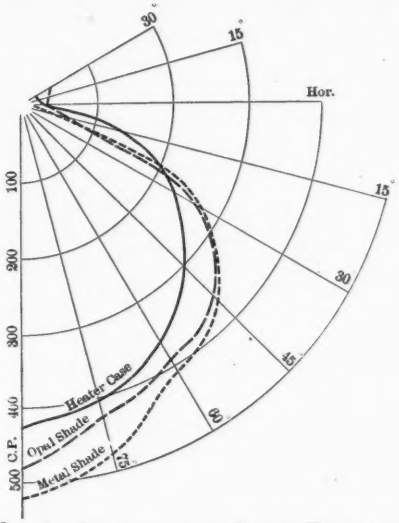



FIG. 4.—DISTRIBUTION OF CANDLE-POWER IN A PLANE PARALLEL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH CLEAR HEATER CASE AND OPAL AND METAL SHADES.

cent in mean hemispherical candle-power, and a maximum variation of thirty-two per cent in mean spherical candle-power.

It is interesting to note the relative candle-power of the one, three and six-glower lamps. In Fig. 6 will be found distribution curves plotted to the same

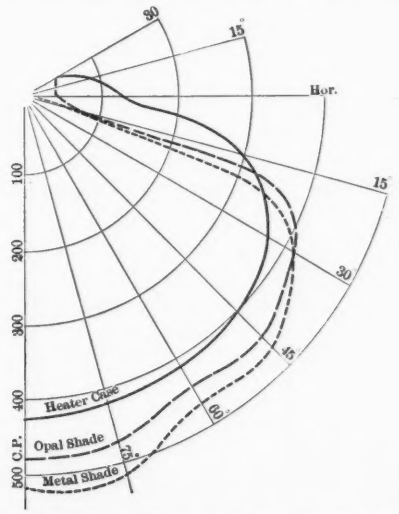



FIG. 5.—DISTRIBUTION OF CANDLE-POWER IN A PLANE NORMAL TO GLOWERS FOR SIX-GLOWER LAMP, EQUIPPED WITH CLEAR HEATER CASE AND OPAL AND METAL SHADES AS INDICATED.

scale for the three lamps, equipped with clear globes. These curves are the mean of parallel and normal distribution.

The relative power consumption per unit of candle-power is shown in table 2, which gives the watts per mean hemispherical and per mean spherical candle-power of each of the three types of lamp.

TABLE 2.

RELATIVE POWER CONSUMPTION PER CANDLE-POWER OF ONE, THREE AND SIX-GLOWER LAMPS WITH VARIOUS GLOBES AND HEATER CASES.

WATTS PER MEAN HEMISPHERICAL CANDLE-POWER.

| No. Glowers. | Opal Heater Case. | Clear Heater Case. | Clear Globe. | Opal Globe. | Sand-Blasted Globes. |
|---|---|---|---|---|---|
| 1 | .... | .... | 2 31 | 4.19 | 2.78 |
| 3 | 3.09 | 2.22 | 2.33 | 4.18 | 2.73 |
| 6 | 2.81 | 1.90 | 1.88 | 3.25 | 2.29 |
| WATTS PER MEAN SPHERICAL CANDLE-POWER. | | | | | |
| 1 | .... | .... | 4.11 | 4.95 | 4.30 |
| 3 | 4.55 | .... | 4 04 | 4.51 | 4.28 |
| 6 | .... | .... | 3.30 | 4.01 | 3.64 |

The table shows clearly that the three-glower lamp is slightly more efficient than

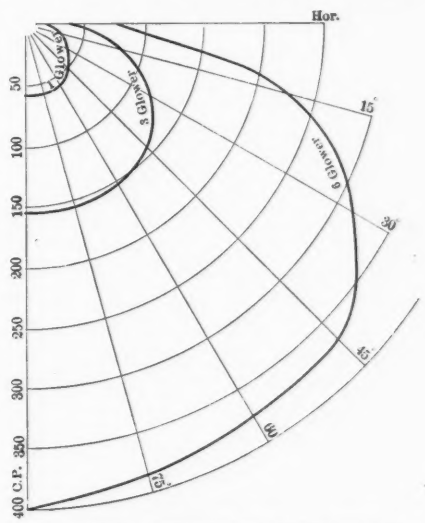



FIG. 6.—MEAN DISTRIBUTION CURVES OF LAMPS EQUIPPED WITH CLEAR GLOBES.

the single-glower lamp, and the six-glower lamp considerably more efficient than the three-glower. This increase in efficiency can be accounted for, if we remember that a number of glowers in close proximity must, through mutual radiation, operate at higher temperature than would an isolated glower. The result is an increase in light output, in spite of the fact that multiple glowers must screen the light from one another in certain directions, dependent upon their arrangement in the holder. Thus, if the number of glowers be increased, in the type of lamp with which we are dealing in these tests, the horizontal intensity will not increase in the same ratio as the downward intensity, because of the screening action of one glower upon another.

The report contains interesting results on the effect of varying the number and arrangement of glowers in the holder. The whole matter may be summed up by saying that increasing the number of glowers augments the efficiency of the

lamp in candle-power per watt, notwithstanding the screening action of the glowers one upon another.

Although the six-glower Nernst lamp takes about twenty per cent more power than either the direct or alternating-current series arc lamps commonly used in street service, yet it is, as regards maximum candle-power, a light source of the same order of brightness, and hence a comparison of the three sources is justifiable. Fig. 7 shows the mean distribution curve of the six-glower Nernst lamp, equipped with metal shade, plotted on the same sheet with the curve for the 6.6-ampere direct-current series arc and the 7.5-ampere alternating-current series arc (see table 3). These arc curves have

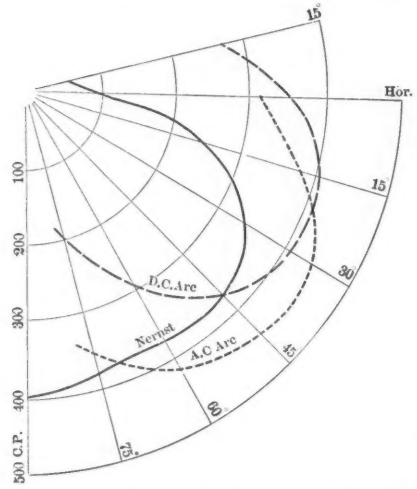



FIG. 7.—COMPARATIVE DISTRIBUTION CURVES OF NERNST AND ARC LAMPS.

been taken from a previous report of the committee. The lamps on which these measurements were made were equipped for street service. The direct-current lamp having an opalescent inner globe and a clear outer globe. The alternating-current lamp having an opalescent inner globe and a metal shade. It will be noted that the candle-power distribution of the Nernst lamp is altogether different from that of either arc lamp. The Nernst lamp is strong where the arc lamps are weak, and vice versa. The points of intersection of the curves form segments which show the superiority in certain zones of each lamp over the other two.

Those who prefer to study curves of illumination, rather than curves of candle-power, will find in Fig. 8 a normal illumination plotted as ordinates against distances from the lamp along the horizontal as abscissæ. All three lamps are suspended at a height of twenty-five feet from the ground. Because of the strong intensity of the Nernst lamp below forty-five degrees from the horizontal, the illumination of points somewhat remote will, in general, be enhanced as the lamp is raised.

TABLE 3.

FOR FIG. 28.

| Angle. | Nernst Six-Glower. | Candle-Power Series Arc A. C. | Series Arc D. C. |
|---|---|---|---|
| Hor. | 87 | 310 | 352 |
| 15° B. | 248 | 375 | 404 |
| 30° B. | 335 | 440 | 410 |
| 45° B. | 373 | 445 | 375 |
| 60° B. | 372 | 430 | 295 |
| 75° B. | 380 | 355 | 200 |
| **Globes.** | **Clear.** | **Opalescent Inner, Street Shade.** | **Opalescent Inner, Clear Outer.** |
| E. M. F. | 226. | 73.8 | 71. |
| Current | 2.4 | 7.5 | 6.6 |
| Watts | 542. | 469. | 459. |
| Mean hemispherical candle-power | 289. | 394. | 360. |
| Watts per mean hemispherical candle-power | 1.87 | 1.19 | 1.27 |

With a view of getting representative results on gas mantles of the Welsbach type, a variety of mantles were purchased in the open market. These mantles were classified according to their retail price, as follows:

Class A, retail price, thirty-five to sixty cents.

Class B, retail price, twenty to thirty cents.

Class C, retail price, below twenty cents.

It was found that the candle-power of a gas mantle is dependent in a marked degree upon the gas pressure. The report contains data on the relations of these two magnitudes. So important is this relation that comparative measurements on mantles become meaningless unless conducted under conditions of constant pressure. Fig. 9 shows the horizontal distribution of candle-power about an ordinary gas mantle mounted in a burner having three side supports for the mantle. It is clear that the distribution would be practically a circle were it not for the screening effects of these supporting rods. It will be noted that there are three depressions in the curve corresponding to the positions of the rods. The minimum horizontal candle-power in this instance is about fifty-seven, the maximum about seventy-six. The position of the supporting rods is indicated in the middle of the figure.

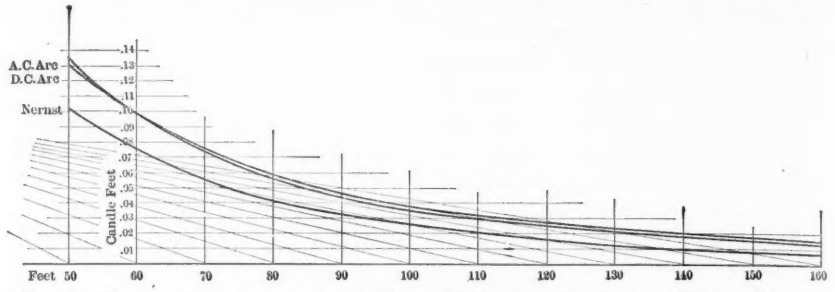



FIG. 8.—NORMAL ILLUMINATION (FROM 50 TO 150 FEET) OF SIX-GLOWER NERNST LAMP, EQUIPPED WITH CLEAR GLOBE.

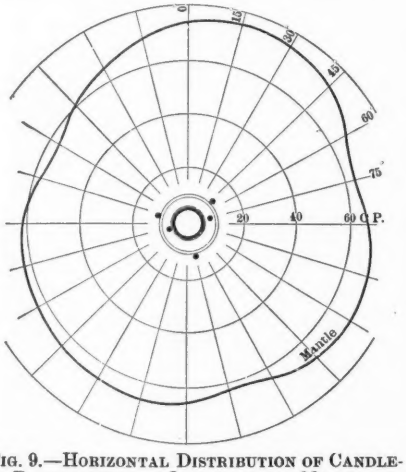



FIG. 9.—HORIZONTAL DISTRIBUTION OF CANDLE-POWER ABOUT AN INCANDESCENT MANTLE.

In Fig. 10 is shown the mean vertical distribution of candle-power from each of the three grades of mantles tested. This winged-shaped distribution of candle-power in a vertical plane is characteristic of the ordinary gas mantle. The maximum candle-power is found at about fifteen degrees above the horizontal, because from this point of view the visible area of incandescent surface is probably a maximum. On account of the position of the maximum candle-power in these curves, the mean hemispherical candle-power is uniformly larger above than below the horizontal. The mean gas consumption for class A mantles working under a pressure of two inches of water is 3.79 cubic feet per hour.[1] The values of gas consumption for grades B and C are respectively 3.66, 3.99 cubic feet per

[1] All instruments used in this work were carefully standardized except the gas meters; time and means were not available to test the meters. The figures for gas consumption will, therefore, have to be understood as indications of ordinary commercial meters.

hour. The mean spherical candle-power for the three grades is tabulated as 55.8, 58.8, 62.2. This means a gas consumption per candle-power of 0.068, 0.062 and 0.064 cubic foot. It is seen that the more expensive mantles give the least candle-power. Whether this is a general conclusion or not can not be said without a larger number of tests than is here described. In point of gas used per mean spherical candle-power, class B leads classes C and A, following in the order named. The real economy of one grade of mantles over another can not be told without a life test. Time was not available for such a test in connection with this work.

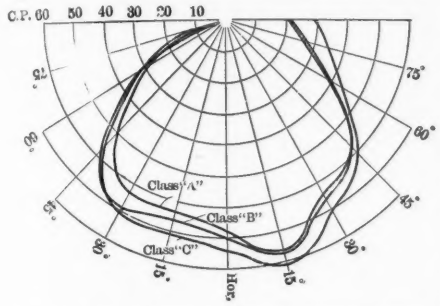



FIG. 10.—MEAN DISTRIBUTION OF CANDLE-POWER ABOUT THE INCANDESCENT GAS MANTLES.

Fig. 11 exhibits the illumination on a plane normal to the ray produced by the mantle burner, placed at a height of twelve feet above the street. The illumination varies from the maximum of 0.187 candle-foot at a distance of ten feet, to 0.0105 candle-foot at a distance of sixty feet. Changing the height of the burner has but little effect on the illumination at points beyond fifty feet from the lamp, but changes in a marked degree the illumination at points near-by. The illumination at a distance eighty feet from the lamp is practically 0.01 candle-foot for all heights of lamp between eight and twenty feet. However, as the lamp is raised between these limits, the mean normal illumination will fall from 0.039 to 0.029 candle-foot.

The report concludes with a short series of tests of the candle-power and gas consumption of the ordinary open gas flame. An assortment of tips was secured from different dealers conveniently at hand. In seeking to test these, it was soon found that the nominal rating of the tip had scarcely any significance, either as regards the gas consumption or candle-power.

Table 4 and Fig. 12 summarize the tests on the open gas flame. It is evident from these tests that the candle-power of gas as found in ordinary commercial service can be determined only by means of a very large number of tests.

Chemical analyses of the gas used in this work show a very considerable variation in the composition of the gas at different times. An analysis made under the supervision of the department of chemistry of Purdue University, on April 23, 1903, concludes with the statement that "The gas is supposed to be a mixture of coal gas and water gas (enriched), but evidently contains a large quantity of natural gas."

The complete report of the committee is quite voluminous, containing some nineteen tables of data and forty-one figures.

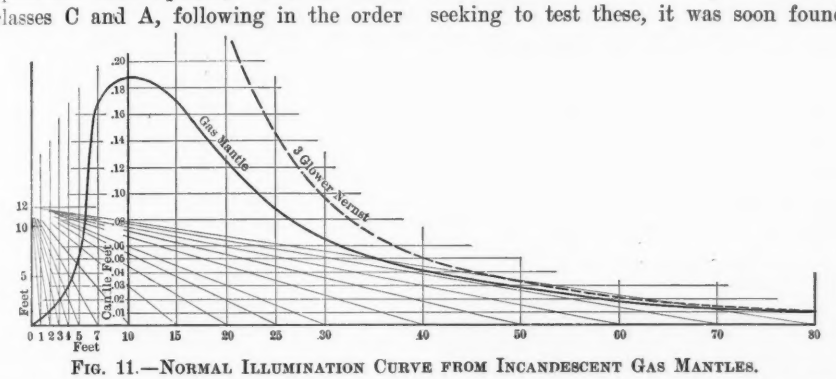



FIG. 11.—NORMAL ILLUMINATION CURVE FROM INCANDESCENT GAS MANTLES.

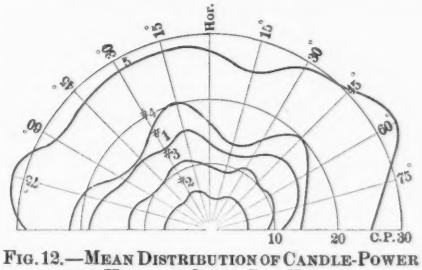



FIG. 12.—MEAN DISTRIBUTION OF CANDLE-POWER FOR VARIOUS OPEN GAS FLAMES.

## *Portrait of Mr. John W. Mackay.*

A portrait of the late John W. Mackay, painted by Miss Cecile de Wentworth, was on exhibition last week at the galleries of William Schaus, New York. Many of the friends of Mr. Mackay called to see the painting, which is to be placed in the directors' room of the Commercial Cable Company, at 253 Broadway, in this city. The portrait, which is full length, is an excellent one, and the artist was highly complimented.

TABLE 4.

FOR FIG. 12.—OPEN GAS FLAME. PRESSURE, 1.2 INCHES OF WATER. CANDLE-POWER.

| Angle. | Tip No. 1. | | | Tip No. 2. | | | Tip No. 3. | | | Tip No. 4. | | | Tip No. 5. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0°. | 90°. | Mean 0° and 90°. | 0°. | 90°. | Mean 0° and 90°. | 0°. | 90°. | Mean 0° and 90°. | 0°. | 90°. | Mean 0° and 90°. | 0°. | 90°. | Mean 0° and 90°. |
| 75° A. | 15.77 | 19.30 | 17.54 | 6.02 | 6.70 | 6.36 | 13.38 | 10.73 | 12.06 | 20.85 | 20.35 | 20.60 | 30.6 | 33.6 | 32.1 |
| 60° A. | 13.38 | 17.27 | 15.33 | 6.90 | 5.23 | 6.07 | 10.40 | 10.80 | 10.60 | 15.12 | 17.68 | 16.40 | 26.2 | 29.4 | 27.8 |
| 45° A. | 15.37 | 14.40 | 14.89 | 6.27 | 5.07 | 5.67 | 9.82 | 10.52 | 10.17 | 14.90 | 16.43 | 15.67 | 26.8 | 29.4 | 28.1 |
| 30° A. | 13.90 | 14.45 | 14.18 | 5.96 | 6.49 | 6.23 | 11.21 | 10.86 | 11.04 | 17.02 | 19.15 | 18.09 | 26.4 | 29.8 | 28.1 |
| 15° A. | 15.00 | 16.09 | 15.55 | 6.16 | 6.03 | 6.10 | 11.01 | 10.92 | 10.97 | 19.10 | 21.00 | 20.05 | 26.3 | 31.3 | 28.3 |
| Hor. | 12.00 | 14.85 | 13.43 | 5.46 | 4.99 | 5.23 | 9.85 | 9.55 | 9.70 | 15.20 | 18.00 | 16.50 | 25.1 | 29.7 | 27.4 |
| 15° B. | 11.51 | 12.27 | 11.89 | 4.44 | 4.76 | 4.60 | 9.11 | 8.94 | 9.03 | 13.22 | 13.73 | 13.48 | 22.9 | 27.1 | 25.0 |
| 30° B. | 12.82 | 12.96 | 12.98 | 5.99 | 5.30 | 5.65 | 10.20 | 11.67 | 10.94 | 15.15 | 16.40 | 15.78 | 26.6 | 30.8 | 28.7 |
| 45° B. | 13.82 | 17.46 | 15.64 | 5.26 | 6.33 | 5.80 | 9.04 | 11.22 | 10.13 | 18.02 | 21.73 | 19.88 | 29.7 | 36.3 | 30.0 |
| 60° B. | 13.43 | 17.80 | 15.62 | 5.24 | 6.49 | 5.87 | 8.95 | 11.92 | 10.44 | 16.90 | 18.20 | 17.55 | 28.0 | 38.5 | 33.3 |
| 75° B. | 12.42 | 15.85 | 14.14 | 4.41 | 7.41 | 5.91 | 7.59 | 12.63 | 10.11 | 11.80 | 19.18 | 15.49 | 27.4 | 29.2 | 28.6 |
| Cubic feet gas used per hour | .... | 5.75 | .... | .... | 3.64 | .... | .... | 4.45 | .... | .... | 6.20 | .... | .... | 9.7 | .... |
| Mean hemispherical candle-power—upper.. | .... | 15.00 | .... | .... | 6.00 | .... | .... | 10.67 | .... | .... | 17.96 | .... | .... | 28.60 | .... |
| Lower | .... | 13.88 | .... | .... | 5.42 | .... | .... | 9.93 | .... | .... | 16.38 | .... | .... | 29.20 | .... |
| Mean spherical candle-power | .... | 14.44 | .... | .... | 5.71 | .... | .... | 10.30 | .... | .... | 17.17 | .... | .... | 28.90 | .... |
| Cubic feet gas used per mean hemispherical candle-power—upper.. | .... | .384 | .... | .... | .607 | .... | .... | .417 | .... | .... | .345 | .... | .... | .339 | .... |
| Lower | .... | .414 | .... | .... | .672 | .... | .... | .448 | .... | .... | .378 | .... | .... | .232 | .... |
| Cubic feet gas used per mean spherical candle-power | .... | .399 | .... | .... | .... | .... | .... | .432 | .... | .... | .362 | .... | .... | .336 | .... |

# The Stone Wireless Telegraph System.

NOW that it has been shown to be feasible to send messages by wireless telegraphy over considerable distances, and that when there is no outside interference reliable transmission can be secured, the practical application of this means of transmitting messages seems to depend upon the development of a system which will not be affected by accidental electrical disturbances in the neighborhood of the stations, and by which the simultaneous transmission of several messages from one or more stations will not cause interference and confusion. In other words, what is needed before wireless telegraphy can be put to general use is a selective system.

This need for a selective system was recognized as soon as it became evident that signals could be sent an appreciable distance without wires, and on this problem not a little ingenuity and labor have been expended by men more or less eminent in this field of investigation. One of these, Mr. John Stone Stone, of Boston, Mass., has accomplished some noteworthy results which apparently indicate that selective signaling is feasible, not only in a scientific experiment, but in actual commercial use. These results have been obtained by a long and exhaustive theoretic study and an experimental investigation. Believing that selectivity could only be secured by devising a system which would respond to but one period of oscillation, Mr. Stone has devoted his time to a study of the conditions which this requirement makes necessary and to the construction of apparatus which will set up and respond to oscillations of but one period. The selection of the best type of coherer is secondary to that of setting up simple harmonic oscillations in the aerial conductor so that he has been content to use whatever type of coherer happened to be most convenient. Various kinds were tried, but that with which the greater part of the work was carried out is a small tripod made of three steel needles attached together at their upper ends and resting on a plate of aluminum. Great sensitiveness was not sought for—indeed, rather the reverse; and the same idea was adhered to in selecting a place for conducting the experiments, the inventor believing that for a system to be of any value it must be able to operate under adverse conditions.

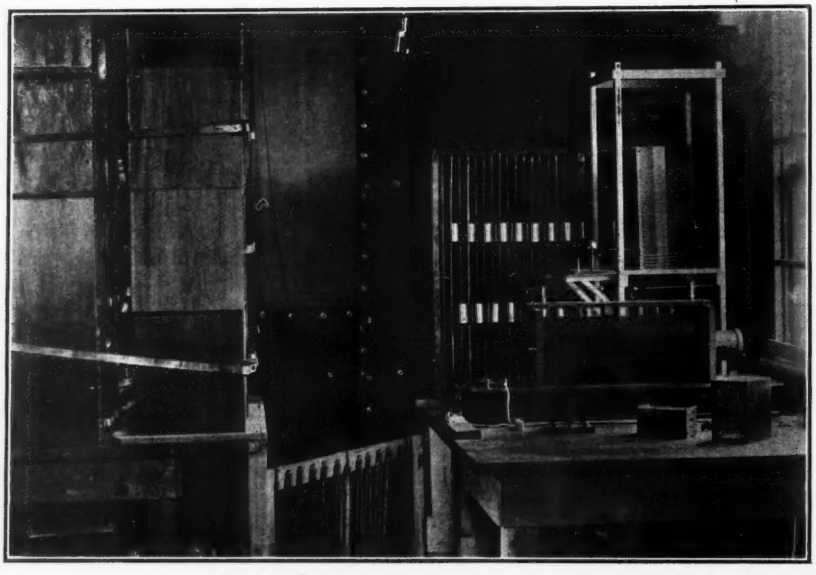
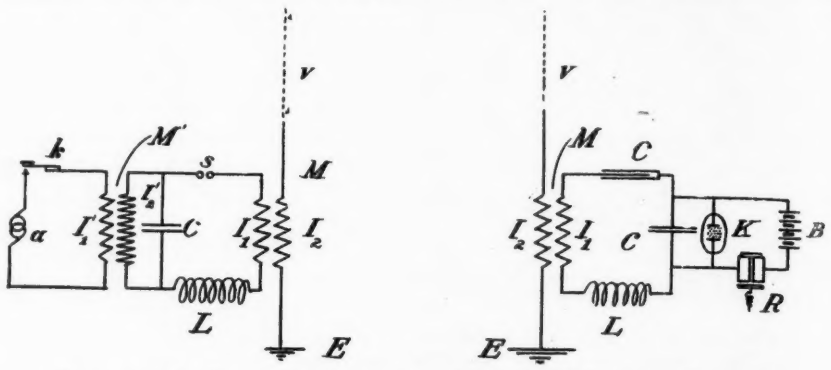


FIG. 3.—ONE SET OF SENDING APPARATUS AT CAMBRIDGE, MASS.

The problem which Mr. Stone then set himself was to devise a sending circuit which would develop electrical oscillations of a simple harmonic character and sufficiently sustained to set into vibration a suitable receiving system that would not respond to oscillations more violent but not simple harmonics. It is also necessary that the receiving apparatus at one station should respond only to its own particular frequency, and must not be affected by sustained harmonic oscillations of a different period. The accompanying diagrams show the system of circuits which was adopted by Mr. Stone. These are reproduced from an abstract of the Stone patents which appeared in the ELECTRICAL REVIEW of December 20, 1902. The general idea of these circuits is this: *a* is a source of alternating current; *k* is a controlling key; M is a transformer for charging the condenser C; *s* is a discharge gap, and L a variable inductance for tuning. $I_1$ is the primary of a transformer, the secondary of which $I_2$ is connected in the aerial wire. When the key is closed the condenser is charged and discharges across the spark-gap through the oscillating circuit *s* $I_1LC$. This circuit is so constructed that these oscillations are harmonic and, by means of the transformer M, they impress forced harmonic vibrations on the aerial wire. These are radiated through space and received by a similar arrangement of circuits, as shown in Fig. 2. It will be noticed that in this system the aerial wire plays no part in fixing the frequency of the oscillations set up, as this is entirely determined by the constants of the oscillating circuit. It was found that simple harmonic vibrations could not be obtained when the vertical wire formed part of the resonant circuit, because of the distributed capacity of the wire, as this distorted the wave-form and introduced harmonics. Moreover, by placing




FIGS. 1 AND 2.—DIAGRAM OF CIRCUITS FOR SENDING AND RECEIVING STATIONS.

the electrical oscillations set up in this the discharging air-gap in the resonant circuit, and not in the vertical wire, the

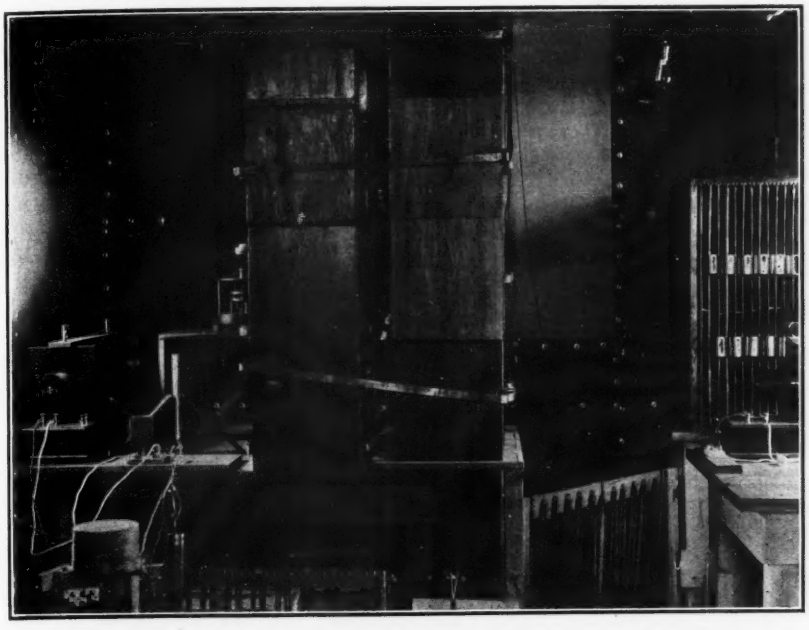


FIG. 4.—ANOTHER SET OF SENDING APPARATUS AT CAMBRIDGE, MASS.

resistance of this is removed from a point where it would greatly interfere with

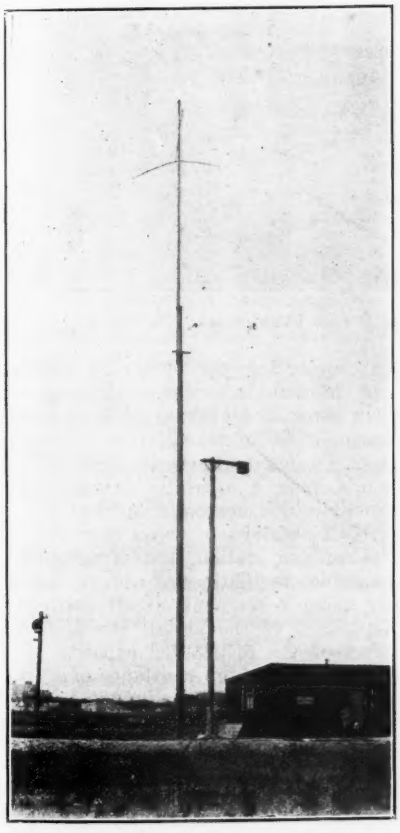


FIG. 5.—SENDING STATION AT CAMBRIDGE, MASS.

the wire by the waves radiated from the sending wire.

This arrangement of circuits having been adopted, the problem was reduced to that of constructing a resonant circuit, the oscillations of which would follow the sine law. To do this all reactions which would distort the oscillations must be eliminated. Thus it was found that the ordinary condensers could not be used, because distortion was produced by the dielectric hysteresis which, although inappreciable at commercial frequencies, becomes serious at the high frequencies used in wireless telegraphy. Mr. Stone has accomplished this by constructing condensers the dielectric of which is air. These condensers are built up of glass plates covered on both sides with tin-foil. In using these condensers at high voltages ionization of the air took place at first at the edge of the tin-foil, but this trouble has been entirely done away with by coating the edges of the tin-foil with beeswax.

Another difficulty encountered in designing circuits is that of reducing the reaction of one coil upon another. If two circuits are tuned independently to a definite period and are then brought near together, the mutual induction of the two upsets the previous adjustment. To get around this it is necessary that the mutual induction be kept small; but if the mutual induction is small, the electromotive force generated in the coil which is acting as the secondary is also reduced. A study of this problem indicated that if two coils, in one of which oscillations are being set up and by it impressed upon the second, are placed close together and then moved apart, the oscillations in the second will die away gradually as the distance between the coils increases, until a point is reached where they begin to increase. Moving the coils further apart, these oscillations very rapidly rise to a maximum, and as rapidly die out. Moving the coils still further apart, a second maximum point may be found. This effect is due, of course, to the decrease in the mutual induction, which at some point allows the coil to oscillate in its natural period. In this way, although the mutual induction between the coils is small, the necessary high potential is obtained by the resonant rise in the coil, and yet distortion of the wave-form is prevented. Experimental study of this gave results entirely confirming the theory. Another advantage of these simple vibrations is that they persist for a longer time, another essential in selective transmission. It has been estimated by Mr. Stone that he obtains as many as 200 oscillations for each discharge of the condenser. With this construction of the resonant circuit, in which hysteretic loss is avoided and the disturbance due to mutual inductance reduced to a minimum, two or more coils may be used in series, each succeeding coil weeding out any distortions which may

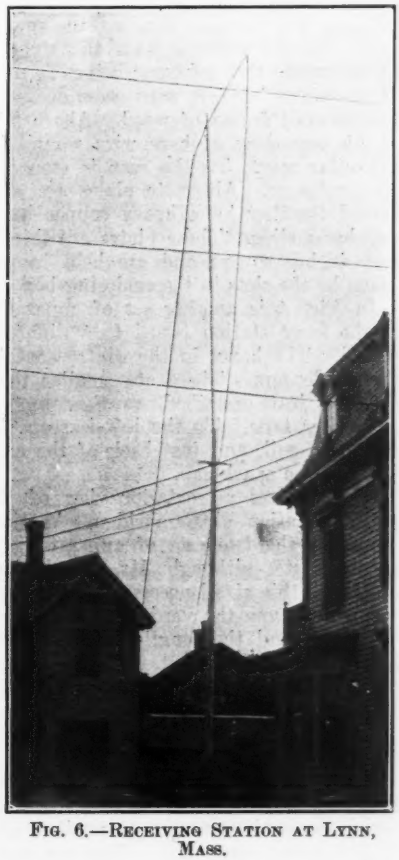


FIG. 6.—RECEIVING STATION AT LYNN, MASS.

have passed through the preceding one, and thus impressing upon the aerial a pure harmonic oscillation.

The same general plan is adopted for

the receiving circuits. The aerial is connected to the ground through one coil, which forms the primary of a transformer, the secondary of which forms part of a resonant circuit. This arrangement was shown in Fig. 2, where M is a transformer; CC condensers, and L an adjustable inductance; *k* is the coherer connected around one of the condensers where the greatest rise of potential takes place; B is a battery, and R is a sounder for indicating when the coherer has been affected.

In this system, as the constants of the vertical wire play no part in determining the period and character of the oscillations, the length of this wire is immaterial. Thus, at the sending station, located at Cambridge, Mass., this wire is about 100 feet long, while at the receiving station at Lynn it is about ninety-four feet. In Fig. 3 is shown one set of apparatus tuned to a definite frequency at the sending station at Cambridge. In front is seen the step-up transformer or induction coil. In the present work a clockwork mechanism, not shown, makes connection with this coil every five seconds by closing a mercury switch. The mercury is at the bottom of the water column, and the hydrostatic pressure of the water forms a very effective brake. Back of this, and just above the coil, are the two balls forming the spark-gap. To the right is seen the step-up transformer, the primary being formed of standard copper wire wound on a cross-shaped frame of wood. Above this is the secondary of bare wire wound in a similar way. To the rear is seen the air condenser. Alternate plates are connected together by a heavy copper band and brass clips. These plates are thirty-four inches square and are held in position by the slots in the enclosing box.

In Fig. 4 is another set of apparatus at the same station tuned to a different period. The boxes in the centre contain the condensers. These are smaller than the one just described, as they are of an earlier type. To the left is seen the induction coil, and just back of the condensers, the spark-gap.

Fig. 5 gives an exterior view of the sending station at Cambridge. Vertical wires for the two sets of apparatus are in duplicate, although Mr. Stone does not think this at all necessary. They are suspended from the yard near the top of the mast, and the length, as mentioned before, is about 100 feet. The aerial current is carefully grounded under the house.

The small pole shown between the house and the larger mast is the mast which was used in earlier work for signaling to the old receiving station, which is about a quarter of a mile north of the house seen here. Between these two stations runs a trolley line, but this in no way interfered with the operation of the system.

Fig. 6 shows the receiving mast at Lynn. Lynn was selected as the point for establishing a receiving station because of the disadvantages presented to wireless transmission from this point to Cambridge. The distance is about ten miles, and the air line passes over Cambridge, part of Boston, part of Lynn, and a number of trolley lines, one of these running just outside of the station at Lynn.

In Fig. 7 is shown one set of the receiving apparatus at the Lynn station. On the central cross-shaped frame is the primary of the transformer which is connected in series with the vertical wire. On each side of this is a coil which forms part of the resonant circuit in connection with the air condensers shown below. In front is seen a telegraphic sounder which acts as an indicator, and a decoherer. The decoherer is a simple tripod of steel needles resting on the aluminum plate just to the right of the sounder. To the right is the relay, which is a modified

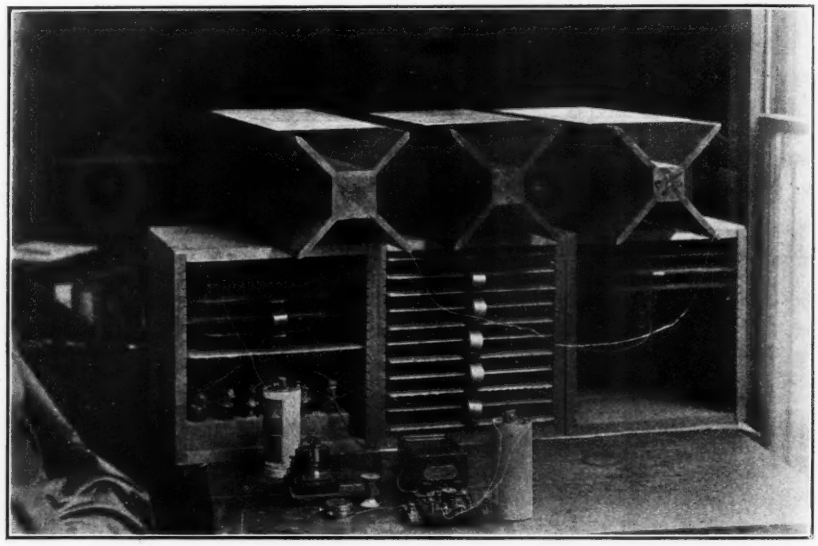


FIG. 7.—RECEIVING APPARATUS AT LYNN, MASS.

Weston-d'Arsonval galvanometer. To the front of this relay is a battery and a potentiometer for obtaining a suitable potential across the coherer. Across the relay is connected a condenser which thus practically short-circuits it for the high-frequency oscillations set up in the resonant circuit, thus eliminating the relay resistance. Back of the sounder is the battery for operating it, and back of that, an electrolytic condenser which, in connection with a resistance, is used to prevent sparking at the relay terminals.

This apparatus is in tune with one set of sending apparatus at Cambridge. There is a second set at this station in tune with the other sending apparatus. The two are adjusted to a difference in frequency of about twenty per cent. Signals can be sent by either set of sending apparatus, and are then received by the corresponding receiving apparatus, without at all affecting the other set. Neither is the work of this apparatus interfered with by the various trolley lines, although when the coherer is connected directly in the aerial its behavior is very erratic, and the passage of a car along the neighboring trolley line seldom fails to operate it.

The behavior of the apparatus can be clearly shown by changing the capacity of the condenser in the receiving circuit when in operation. If while the signals are being received the condenser plates are shifted slightly, the signals at once cease. Moving the plates back to the original position causes the signals to commence again. When signals are sent by one set of apparatus, tuned to one frequency, they do not affect at all the receiving apparatus tuned to the other frequency; but, by moving the plates of the condenser in the receiving circuit, this can be tuned to the frequency of the signals, and the sounder at once responds.

To sum up, in this system Mr. Stone has constructed an oscillating circuit which gives simple harmonic vibrations by eliminating the effects of hysteresis and mutual induction. He secures a high potential by taking advantage of the resonant rise of potential in his two circuits. To actuate the receiving device he depends upon a carefully tuned resonant circuit which responds to the comparitively long series of waves sent out from the sending station, but is not affected by sudden oscillations of a short duration. By using a resonant circuit entirely independent of the aerial, the deleterious effect of the distributed capacity of the latter and the high resistance of a spark-gap in this circuit are eliminated, and the frequency of the electrical oscillations taking place in the apparatus is independent of the height and electrical constants of the vertical wire. While all the experimental work has not yet been done, enough has been accomplished to indicate the practicability of selective wireless telegraphy by means of properly constructed and properly adjusted sending and receiving apparatus.

# The Ohio Electric Light Association.

*The Ninth Annual Meeting of the Ohio Electric Light Association Was Held at Hotel Chittenden, Columbus, Ohio, on October 13-15, 1903.*

THIS association, comprising as it does in its membership all of the principal central stations of Ohio, always holds interesting meetings, and this was no exception. The programme was a departure from the ordinary in that it gave considerable attention to the boiler and engine-room economy and equipment. The attendance, however, was not what it ought to have been, and it is thought by some members that the dates are set too late in the fall, when the busy season keeps many from attending.

The following active members were in attendance:

Geo. Hayler, the Gas L. & P. Company, Van Wert; W. F. Hubbell, of H. H. Williams & Company, Wauseon; E. H. McKnight, of the L. E. B. G. & N. Ry. Company, Bowling Green, and the Middleton E. L. & P. Company; Geo. Matt, Lancaster El. Lt. Company, Lancaster; H. Smith, Mansfield Ry. L. & P. Company, Mansfield; S. M. Rust, Piqua Elec. Company, Piqua; L. G. White, J. M. Plaisted, V. S. Kohler, the Columbus Railways & L. & P. Company, Columbus; M. E. Turner, Cleveland Elect. Ill'g Company, Cleveland; E. F. Gwynn, Delaware Elec. L. & P. Company, Delaware; E. J. Bechtel, Toledo Railways Company, Toledo; J. H. Perkins, E. H. Beil, the Youngstown Consolidated Gas & Elec. Company, Youngstown; A. C. Blinn, Sandusky Gas & Elec. Company, Sandusky; D. L. Gaskill, John Riddle, Greenville Elc. Company, Greenville; C. R. Lutz, Citizens' Elec. Lt. Company, Logan; F. E. Valentine, Urbana Elect. L. & P. Company, Urbana; E. W. Plaisted, Frank Espy, Kenton Gas & Elec. Company, Kenton; A. W. Field, Columbus Edison Company, Columbus.

SUPPLY MEN IN ATTENDANCE.

Adams-Bagnall Electric Company—W. V. Orr, Cincinnati; F. L. Druliner, Cleveland.

American District Steam Company—H. B. Kimbrough, Chicago.

Bryan-Marsh Company—F. H. Haughton, F. W. Godfrey, Cincinnati, Ohio.

Buckeye Electric Company—R. M. Barwise, Cleveland; R. M. Hemming, E. E., Columbus.

Babcock & Wilcox Company—W. D. Chester, Pittsburg, Pa.

F. Bissell Company—C. M. Hamilton, Toledo.

Crocker-Wheeler Company—H. A. Brown, E. E., Chicago.

Hart Manufacturing Company—William Crichton.

Doubleday-Hill Electric Company—C. P. Hill, Pittsburg; Elliott Reynolds.

Electric Appliance Company—O. T. Kimmel, Columbus, Ohio; Perry R. Boole, Chicago.

Erner-Hopkins Company—W. A. Hopkins, Jr., Columbus.

Fort Wayne Electric Works—T. J. Ryan, Cincinnati; George B. Edgar, Cincinnati.

G. I. Arc Light Company—W. F. Geddes, 3d, Cleveland, Ohio; H. B. Coles, Cincinnati.

General Electric Company—W. M. Demming, manager; W. J. Hanley, H. C. Houck, S. D. Gilbert, Cincinnati; Matthew O. Troy, Schenectady, N. Y.

Kuhlman Electric Company, Elkhart, Ind.

W. G. Nagel Electric Company—W. G. Nagel, E. J. Paradis, J. M. Wood, Toledo, Ohio.

Post-Glover Electric Company—Charles S. Kuntz, Cincinnati.

Nernst Lamp Company—D. D. Strite, Pittsburg.

National Electric Company—Charles G. Burton, Chicago.

National Carbon Company—F. H. McDowell, Cleveland.

Otis Elevator Company—A. H. Wright, Cleveland.

J. A. Roebling's Sons Company—W. P. Bowman, I. W. Brooks, Cleveland, Ohio; W. W. Affleck, Cleveland, Ohio.

Standard Electric Company—P. J. Williams, Cincinnati.

Stanley Instrument Company—F. J. Alderson, Great Barrington, Mass.

Stanley Electric Manufacturing Company—O. H. P. Fant, Cincinnati.

Sprague Electric Company—O. P. Fant, Cincinnati.

Westinghouse Traction Brake Company—Wm. D. Ray, Cleveland.

Western Electric Company—Charles W. Cobb, Cleveland.

Westinghouse Electric and Manufacturing Company—Nathaniel Paige, Jr., Leon Goldsmith, Columbus, Ohio; J. W. Schrantz, Cincinnati; K. C. Randall, E. E., Pittsburg.

Lehman B. Hoit, C. E., Cleveland, Ohio.

It will be seen by the above list that the meeting was well attended by representatives of companies dealing in electrical supplies and materials.

The General Incandescent Arc Light Company exhibited its multiple alternating-current and direct-current lamps in operation, and series alternating-current arc lamps in both shunt and differential types; showing the knife-switch, automatic switch, remote control; also Wright-demand meter.

Roeblings made no display, but distributed souvenir wire gauges. These were in great demand.

The W. C. Nagel Electric Company, of Toledo, exhibited the Nernst lamp in operation in various sizes.

The General Electric Company had a special display of its new Meridian lamp and its concentric light diffuser.

The Stanley Electric Manufacturing Company exhibited a line of meters in operation.

The Bryan-Marsh Company had on exhibition its new type lamp, burning out at the eighty per cent line of initial candle-power.

The exhibit of arc lamps by the Adams-Bagnall Electric Company, of Cleveland, handled by the Electric Appliance Company, of Chicago, was very complete. Here were also shown the Gutmann wattmeter and the Packard incandescent lamp and transformer.

The National Electric Company, of Milwaukee, showed a line of enlargements representing its various types of direct-current and alternating-current generators and motors, belt-driven and engine type. The company also gave away steel tape-measures to all callers.

The above were all the regular exhibits, but the traveling men from the other houses represented were attentive and ever present and made up in personal attractiveness what they lacked in material exhibits.

A theatre party was given Tuesday night by courtesy of the Erner-Hopkins Company, the Columbus Railways and Light Company and the General Electric Company.

The Engineers Club, of Columbus, offered the use of its rooms, and the president and faculty of the Ohio State University received the members of the association as guests on Wednesday evening.

Officers elected during the session for the ensuing year are as follows:

President, S. M. Rust, Piqua.

Vice-president, J. H. Perkins, Youngstown.

Secretary-treasurer, D. L. Gaskill, Greenville.

Advisory committee: D. L. Gaskill, Greenville; Samuel Scovil, Cleveland; L. G. White, Columbus.

Executive committee: A. W. Field, Columbus, Ohio; W. F. Hubbell, Wauseon; A. C. Blinn, Sandusky; J. F. Bendure, Lima; C. Johnson, Akron.

Finance committee: E. H. McKnight, Middletown; Edward Plaisted, Kenton; E. F. Gwynn, Delaware.

President A. W. Field, of Columbus, in his annual address briefly reviewed the objects of the association, the fostering of the common interests of its members, the advancement of scientific and practical knowledge in matters relating to electric light and power companies, and the establishment of cordial and beneficial relations with kindred associations.

Mr. W. D. Chester, of Babcock & Wilcox Company, Pittsburg, read a paper on "Steam Boilers for Power Plants," in which, after commenting on fuel values, he passed to a consideration of various types of boilers, and after referring to the advantages of superheated steam, predicted that in the near future results would be obtained with superheated steam of one pound of coal per indicated horse-power on daily average running.

Mr. D. S. Kohler, of the Columbus

Railways and Light Company, opened the discussion, and asked if the essayist had any data as to amount of saving from use of superheaters and as to how the superheaters made by his company compared with those known as independent superheaters.

Mr. Chester stated that his company made both kinds, but the separately fired had not met with much success. A test of a McIntire compound steam engine in Columbus, after running the same battery two days not superheated, and then two days superheated, showed a saving of ten or eleven per cent in pounds of water evaporated per kilowatt generated.

Professor Hitchcock declared in favor of a fire brick arch or Dutch oven Turner furnace, especially with use of bituminous coal, as a means of protecting the heating surface and tending to distribute the heat better.

Upon again assembling on Wednesday, the first paper read was by Mr. E. J. Bechtel, of the Toledo Railways Company, on "Engine Economy and Equipment." Mr. Bechtel seems to regard with some favor the possibilities of the steam turbine for central station requirements, their capacity at present being limited to 500 kilowatts per unit for direct-current work; gas engines were a doubtful factor; it is necessary to carefully weigh all conditions in deciding upon equipment, and after all the economy of the plant depends largely upon the personal equation of the operating force which it is peculiarly desirable to carefully select. Men should be treated so as to ensure their feeling that no favors would be shown, but their advancement would depend upon merit strictly.

Professor Magruder, of the Ohio State University, being invited to speak upon the subject, came to the rescue of the gas engine; he thought unfavorable opinions had come from gentlemen who were unfamiliar with the gas engine's capabilities. He instanced a plant in Lancaster, which had been using gas engines for five years for electric lighting work satisfactorily. Gas engines of 150 horse-power had worked on about ten cubic feet per brake horse-power-hour, which he considered was equivalent to something under twelve pounds of steam per brake horse-power-hour; so that when it came to the question of heat units the gas engine can deliver the goods. One of his German friends had written that he had designed a 5,000-horse-power unit, and one of his own students had designed a forty-five by fifty-four, crank-pin twenty inches in diameter, that is being built by the Allis-Chalmers Company. The foreign makers were guaranteeing regulation of their gas engines, and in America there is a great future for the gas engine.

The paper by Mr. J. H. Perkins, of the Youngstown Consolidated Gas and Electric Company, illustrated the advantages to be derived in a plant of average size by combining all classes of service in increasing the load-factor, and showing how the plant has developed from one of small capacity operating many kinds of service from as many types of machines to one of comparatively large capacity operating all classes of service from only one type of machine. Within the past three years the Youngstown plant has discarded all belt machines and all generators of any kind other than the two-phase alternating-current type. Their commercial series arc light machines have been thrown out in favor of constant-potential alternating-current arc lamps on meter; while the direct-current series open arcs for street lighting have been replaced by constant-current alternating-current apparatus. All possible direct-current power service has been changed by the use of single and two-phase motors, the remaining 500-volt direct-current service being furnished by rotary transformers, so that the prime movers may all be of the same type.

Questions were asked by Messrs. Bechtel, Hayler, Bailey, Professor Caldwell, and Mr. McKnight, which were replied to at some length and in elaboration of the facts stated in the paper. He stated that they had to-day practically no trouble with their rotaries, although they had at first experienced some by reason of their not operating on the vertical engines. Some of his substations are not inspected once in three months because not found necessary. They were understood to be the pioneers in the operations of sixty-cycle rotaries, and had now found how to operate them without any trouble, the commutator being the principal thing that requires watching.

The paper by Mr. George Hayler, Jr., of the Van Wert Gas, Electric and Power Company, on "Steam Records" was listened to with close attention. The writer believed that it is altogether due to the intelligent study of proper records and the application of the knowledge derived therefrom that the cost of producing electrical energy has reached the low figure quoted by some of the larger companies. The smaller companies would do well to look after this question of records more thoroughly. Mr. Hayler gave many suggestions of a practical character looking toward the detection and remedying of waste, and summarized the details which, in his judgment, the average central station throughout the country should make a matter of record.

Mr. A. C. Blinn, of the Sandusky Gas and Electric Company, read a paper on "Value of Station Records." He contended that this was as essential to the proper operation of a small as of a large plant, that complete records be kept and carefully studied daily. This is the only way in which to work intelligently toward broadening the peak, and stopping little leaks in consumption which at the end of the year have a very material effect upon the balance-sheet; where records are lacking a prospective buyer instead of being hoodwinked is rather all the more apt to depreciate the true value of the plant upon the assumption that there is something wrong where no records have been kept. As a means of discipline close attention to the matter of keeping a record has a salutary effect upon employés; it is also valuable in convincing employés of their own derelictions or shortcomings which otherwise they would charge up elsewhere. The cost of installing a complete system of records is trifling in comparison to the advantages derived, provided the information compiled is intelligently studied and availed of.

The paper by the Hon. D. L. Gaskill, on the "Municipal Code of Ohio," as affecting electric light plants of the state, was a comprehensive résumé of the subject. The writer said that in many ways the new code had proved a disappointment.

These papers rounded out the morning session of Wednesday, and recess was taken until 2 P. M.

The first paper of the afternoon session was that by Mr. K. C. Randall, of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa., on "Some Practical Considerations and Applications of Transformers." The writer took up four points as of especial interest to the station operator: (1) the first cost; (2) amount of power consumed in losses; (3) the continuous and overload capacity; (4) the life of the transformer. These were considered with reference to different classes of service, attention being paid to the time of heavy load and light load; also to the requirements where overload might exist. By means of definite examples the relative value of two transformers was illustrated; also the su-

periority of a transformer which normally operates at a low temperature rise, and, therefore, having large overload capacity, over one with a high temperature rise, and, therefore, little or no overload capacity. As a summary, durability, life and low temperature were shown to be practically synonymous and the result of low losses in a good design.

The paper further stated the importance of replacing many small transformers by a single larger one, and illustrated this by a definite example showing the actual monetary gain by such a change, as well as the gain due to putting several transformers in reserve which were replaced by the single larger transformer.

In the discussion Mr. Troy, of the General Electric Company, Schenectady, asked if the other qualities of a transformer, such as regulation, $C^2R$ loss, etc., might not be limiting features just as much as heating? Most central station men are equally concerned with the matter of regulation and copper loss. The overload capacity of a transformer is just as much a function of the regulation and $C^2R$ loss as it is of the heating. Mr. Troy urged the necessity and desirability of a fixed standard of temperature on which to base regulation and efficiency of transformers under discussion. If such a universal standard was accepted he thought the standard set by the American Institute of Electrical Engineers, namely, fifty degrees centigrade maximum rise, is the logical one to accept.

Mr. Troy thought that in operating a line containing transformers of various ratios the lamps on the line would be subjected to dangerous voltages under light load conditions, and it might well be asked, how much would this voltage vary during different parts of the day in the example cited by Mr. Randall, where transformers of three different ratios, nine, nine and one-half and ten to one were used on the same line? Would not the saving in line construction be more than offset by the poor all-day efficiency of the transformer, etc.?

Mr. Randall replied that as to using a nine to one ratio all over a community instead of just at different places, if used all over the iron losses which are pointed out as being very prominent would be increased, but would even then be quite low, while the gain in regulation and gain in reduced copper loss would perceptibly offset the iron loss, and there would be better regulation, which would be a substantial gain. In reply to a question by Mr. Hoit, regarding the relative efficiency of a fifty per cent and a 150 per cent load, that Mr. Randall said would depend upon the proportions of iron and copper loss. Assuming a transformer with an iron loss of say one and one-half per cent, and a copper loss of say two per cent, at one-half load the iron loss would come down about sixty-six per cent or just about to one per cent, and the copper loss would go up to about four and one-half per cent.

Mr. Turner thought that regulation was one of the most vital points in the distributing system; if you can not maintain a uniform voltage on your distributing system, you lose one of the great advantage that electric light has in competition with other illuminants. If at light load the lamps will receive a very high voltage and are burning at standard voltage only at the time of maximum load, it not only means that the lamps' life is shortened, but that those customers who have their maximum current at an earlier period than others will notice the difference between the candle-power of their lamps at one time of the day and what it is at another time. The question of candle-power is mostly one of comparison. The best way to maintain a distributing system is by the use of feeders and subfeeders; otherwise uniform voltage can not be maintained.

In the absence of Mr. Mosman, of the General Electric Company, Schenectady, Mr. Troy read his paper, "Notes on Certain Three-Wire Systems."

Mr. Bechtel stated that in Toledo they used a three-wire direct-current system for downtown lighting business districts, and a single-phase alternating-current in the residence portion. Have three-phase four-wire generators; balance, single-phase. Feeder lines are arranged with main feeders and subfeeders on the primary mains so as to give as nearly equal distribution over the whole territory as possible. The three-wire direct-current system is entirely underground; it is an interconnected network, mains fed at different points from the station by three-wire feeders. Have a rotary converter as a tie in between the two systems. It will convert alternating current to direct-current, or vice versa, making a flexible system and requiring somewhat less machinery for peak load; peak on the direct-current is at 5.30 in winter time, and on alternating current about 8 o'clock. That in a measure does away with duplicate machinery.

The session closed with the reading of a paper by Mr. Lehman B. Hoit, C. E., of Cleveland.

The Thursday morning session opened with routine reports, that of the secretary-treasurer, Mr. Perkins, showing a healthy balance in the treasury, and was referred to the finance committee.

The executive committee asked that the matter of fixing time and place of next annual meeting be referred to the incoming executive committee, which was concurred in.

In the absence of Mr. W. F. Raber, of Mansfield Electric Light and Power Company, his paper entitled "Electrical Distribution in the Engine Room" was read by title and authorized to be included in the regular minutes.

Professor F. C. Caldwell, of the Ohio State University, read his paper entitled "The Combined Use of Alternating and Direct Current for Central Station Work." The paper was a comprehensive one, and listened to with interest which was heightened from the fact that both on the occasion of this and former meetings Professor Caldwell has entertained the members of the association at the University in conjunction with other members of the faculty. The following members of Professor Caldwell's senior class in electrical engineering took part in the discussion: J. G. Campbell, G. M. Cameron, C. F. Kettering, H. S. Bostater, W. A. Schertz, J. S. Riddle, E. W. Benedict, A. S. Stewart, L. S. McGarey, T. Crocker, W. Kalb, Edward Sill, J. W. Gwynne, Fred Nesbit, H. L. Beach, J. E. Powell, F. B. Pelton and W. Kempton.

Mr. M. C. Hull, of the Columbus Railways and Light Company, read a paper entitled "Methods and Means of Securing New Business." His suggestions were practical, especially that in reference to cultivating the architect, and looking after the electric wiring of all new houses, many of which but for such precaution being taken would be finished without wiring.

In discussing the paper Professor Caldwell said that the great convenience from the use of electric current was a point that could never be overdrawn when approaching a customer, especially in a natural gas territory where there was so much to contend with; the case of turning on an electric light in a cellar or any remote part of the house without striking a light was a great inducement as a matter of convenience.

The convention adjourned to meet at such time and place as may be hereafter determined by the executive committee.

# Reviews of Current Engineering and Scientific Literature.

### *A Double-Frequency Generator.*

In the issue of the ELECTRICAL REVIEW of October 10, a review is given of a serial by Mr. E. J. Brunswick on the application of polyphase motors to driving centrifugal drying machines in the sugar refinery at Cambrai, France. These motors are started by connecting them successively to circuits which are supplied at frequencies of twenty-one, thirty-five and fifty cycles per second. The latter frequency is the standard for the refinery, and the two lower frequencies, used for starting only, are given by a single double-frequency generator. This is a machine of the inductor type, having two stationary armatures and a revolving inductor with two sets of poles. The machine is excited by a single fixed field winding, current for this purpose being drawn from an exciter mounted on an extension of the generator shaft. The generator is rated at 300 amperes at 150 volts, twenty-one cycles, and 300 amperes, at 250 volts and thirty-five cycles, in each case with a power-factor of 0.6. One end of the rotor has three poles and the other five. The interior diameter of the armatures is 1.10 metres. The twenty-one-cycle armature has seventy-two slots, with a six-pole winding connected in star. The thirty-five-cycle armature has 120 slots, with a ten-pole winding connected in star. This size of generator was decided upon in order that it might furnish power to more than one motor at a time. The machine is used for starting twelve motors rated at thirty-five horse-power each, and which are designed to bring the centrifugal machines up to full speed within one minute. —*Translated and abstracted from l'Electricien (Paris), September 26.*

### *Chemical Valency, Electrical Conductivity and Hardness of Metals.*

This is a theoretical consideration by Mr. John G. A. Rhodin, of the molecular structure of matter, the aim being to connect in some way the chemical, electrical and mechanical properties of various substances. The author assumes metallic induction to consist in a harmonic vibration of the molecules. As the adjacent ones come in contact, the electrons are passed from one to the other under the influence of the electrical stress. The author deduces equations from this assumption, and reaches the conclusion that the hard metal has more complicated molecules than the soft one, and will therefore have a higher resistance, since the mobility of the molecules must be less. Non-conductors, as a general rule, have molecules of unusual magnitude. To elucidate the difference between metallic conductors and all other substances; the following criteria are suggested: All metallic conductors are composed of ultimate particles which can act as cathions without the intervention of other elements. The ultimate particles are thus electrically uniform. All electrolytic conductors are composed of ultimate particles of two kinds—one or more cathions and one or more anions, which readily dissociate by the influence of a solvent or fusion. They are thus electrically binary. All dielectrics are characterized by an exceptional resistance offered by their ultimate particles against molecular motion, depending upon either the exceptional size and mass of its molecular combinations, if solid, or internal friction if liquid. They are electrochemically uniform. The electrical behavior of any substance is a function of the absolute temperature.—*Abstracted from the Electrochemist and Metallurgist (London), September.*

### *Electricity Supply in Milan.*

The hydroelectric station at Paderno, Italy, transmits the greater part of its output to Milan. This is conducted to the station at Porta Volta, where there is an auxiliary steam plant. The rated output of this steam equipment is 13,000 horse-power. The most recent additions to this are a Parsons turbine of 3,000 horse-power, coupled to a Brown alternator and a Parsons-Brown turbo-alternator of 4,-500 horse-power. These are run condensing, jet condensers being used, the pumps being driven by geared induction motors. Power is received from Paderno at a pressure of 12,600 volts, and is transformed down to 3,700 volts, there being twenty 400-kilowatt transformers grouped in parallel and connected to the station bus-bars. Power from this station is supplied to 3,000 three-phase motors, representing over 10,000 horse-power, compared with which the 77,000 incandescent lamps and 725 arc lamps are of secondary importance. The Santa Radegonda station supplies direct current by means of motor-generators to the amount of 2,500 kilowatts for traction and 1,870 kilowatts for lighting, supplemented by Tudor batteries of nearly 2,000 kilowatts for traction and 2,500 kilowatts for lighting. This station supplies 80,000 incandescent lamps and 1,000 arc lamps, as well as 300 cars. Besides the supply to Milan proper there is a large demand from the surrounding districts. The principal tramway line outside of the city is that which runs to Monza. This is supplied through the substation of Sesto San Giovanni, which is equipped with synchronous converters and a large storage battery. The whole undertaking has a maximum load of 16,000 kilowatts.—*Abstracted from the Electrical Review (London), September 25.*

### *Motor Car Reliability Tests in England.*

The object of the Automobile Club, under whose auspices a series of reliability tests was conducted recently in England, is to give the public an opportunity of ascertaining which is the best and most reliable car obtainable. Brake, noise, vibration and dust trials were held at the Crystal Palace grounds, and these were followed by reliability tests extending over several days. The first day's journey was to Margate and return, a distance of 150.5 miles, and was performed in fine weather. One hundred and four cars started. Several were in difficulties toward the end of the day, and the official summary showed that thirty-five cars made non-stop runs, twenty-six had trifling stops, and twenty-eight longer delays not of a protracted character. On Friday ninety-three of the original 104 started on the second day's journey, which was to Osbourne and back, 121 miles. Twenty-three cars returned to the palace within the specified time, fifty returned with trifling delays, and fifteen returned later. On Monday eighty-six cars started for Worthing, 118.75 miles, and it was during this journey that the most difficult hill-climbing test took place. After leaving Dorking the hill rises toward Bury 338 feet in three-quarters of a mile, with an average grading of 1 in 11.74, but with some sections as steep as 1 in 8.75. This hill showed that some of the less expensive lighter and less powerful vehicles could do just as good work as the more expensive, and that much depended upon the skill of the driver. The results at night-time showed that thirty-eight cars made non-stop records, and forty-two were delayed by a few minutes. On Tuesday the course was laid to Folke-

stone and back, and eighty-four cars started. This route has many sharp turns, so that the skill of the drivers was put to test. Thirty-nine cars made the trip without stopping, and thirty-two had delays of a few minutes. On Wednesday the route was to Southsea. On Thursday seventy-seven cars started on the run to Bexhiel and back. During this run a straight course for 880 yards allowed speed tests to be made. The cars had a flying start and some traveled at the rate of over forty miles an hour. The day's results showed that forty-six cars made non-stop records, and twenty-seven suffered slight delays. The results of this series of severe tests would seem to show that a marked advance has been made in mechanical efficiency and reliability.—*Abstracted from the Railway News (London), September 26.*

### *Preventing Disturbances to Telegraph and Telephone Systems Caused by Using the Earth as a Return.*

In this article on electric trolley vehicles without rails, M. Emile Guarini describes a system which he has devised for the purpose of preventing disturbances to feeble electrical systems such as the telephone and telegraph, caused by other more powerful systems using the earth as a return. The means he has tested is analogous to the three-wire distribution system. It consists in dividing the current between two circuits, both earthed at each pole, the earth connections of the respective circuits at each pole having opposite polarities. The intensity of the current is substantially equal in the two circuits. A very sensitive galvanometer placed in circuit will not indicate any current. In other words, what is needed is to neutralize by a charge of contrary sign the charge which each ground of the galvanometer circuit receives from the current from the earth plate connected to the dynamo. The author does not think that it will be impracticable to use the ground return for a vehicle which does not run on rails, if the power is supplied at a high voltage. A bad ground connection will be immaterial when the pressure is thousands of volts. He has personally made experiments in wireless telegraphy from a moving vehicle, using a telephone receiver, and, as a return, the wheels of a truck resting on the street pavement. The potential was 30,000 volts, and no difference in the intensity of the sound given by the telephone receiver could be detected, whether the grounding was through the wheels resting on the pavement or through a rod sunk deep in moist ground.—*Abstracted from the Engineering Magazine (New York), October.*

### *Electrical Wiring Fire Risk.*

The proper precautions to be observed when installing and for the care of electric wiring are here discussed by Mr. E. C. de Segundo. Experience has shown that a building lighted by electricity enjoys complete immunity from risk of fire, provided, always, that the erection of the wires and fittings has been carried out in a sound and workmanlike manner. If satisfactory work is to be done, attention must be paid to the following points—the means adopted for insulating wires, the means adopted to prevent mechanical injury to the insulation of the wires, the subdivision of the main circuit and the proportionate size of the conductor to the work it is to do, the means adopted to guard against accidental overloading of the conductor, the nature of the joints made in the conductors, the design of the fittings, with special reference to ease in wiring without injury to the conductor, the method of manufacture and erection of fittings and accessory apparatus, and the general scheme of wiring and method of fixing in place all of the wiring fittings, so as to avoid danger from the proximity of gas and water pipes and ironwork of all kinds. All these points are covered by the statement that the essential condition of a properly erected wiring installation consists in providing that the electric current be kept within its prescribed bounds, and that if by any contingency a way should be opened for the current to travel in an unauthorized direction, the supply should be cut off automatically and instantly. The conductor wires should be of copper and should carry the maximum current without any perceptible heating of the conductors to the touch. In addition to adopting a safe current density, a maximum fall of potential should be specified for any one circuit. Dampness must be guarded against, as it is most insidious in its action. It may arise from a variety of causes and, particularly in the case of new buildings, is apt to be of an acid nature. The author would like to see every wire in a house treated as if it were a submarine cable. Unfortunately, gutta-percha is useless for wiring houses, because it is extremely sensitive to the oxidizing action of the atmosphere and becomes plastic at a temperature only slightly elevated above the normal. The ideal method of wiring a building is to use nothing but the highest class vulcanized rubber insulation covered with a braid and enclosed in a continuous system of cold-drawn steel tubes, especially selected for smoothness of bore, with joint boxes inserted at all points necessary, so that the wires may be drawn in without injury and may be easily inspected. This system is somewhat costly, but according to certain estimates made by the author the increase in cost over the wooden moulding system was not more than twenty-five per cent.—*Abstracted from Insurance Engineering (New York), September.*

### *Electrical Towing on Canals.*

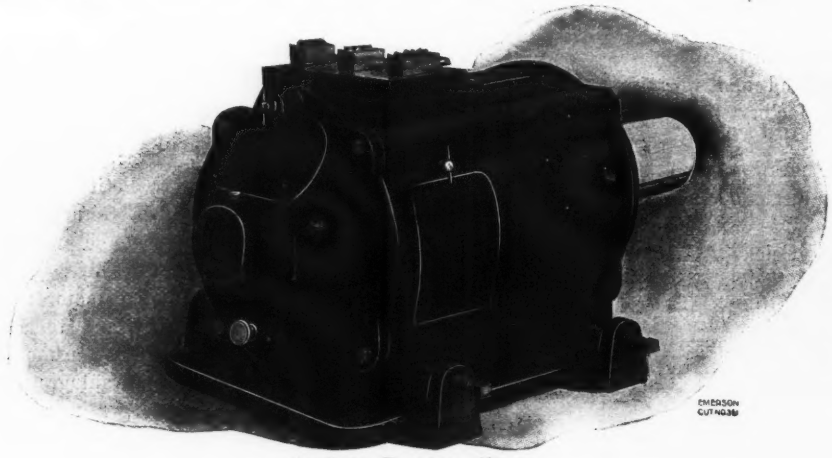
Mechanical towing of boats on canals is not new. It has been tried on several well-known waterways with more or less favorable results, but little has been published beyond a mere description of the installation. M. Georges Petit describes the researches of M. Léon Gérard, who has made a careful study of the problem. Two systems of haulage are investigated—that in which the tractive motor runs over an ordinary towpath, and that in which rails are laid down for the motor. To determine the relative advantages possessed by the two systems it was necessary to compute the starting effort required and the average pull necessary to maintain the desired speed. The effort required to overcome the inertia of the boat is easily computed from its known weight. That required to overcome the friction of running water could only be determined experimentally. This was done by bringing certain boats up to a convenient speed, then cutting off the driving force, and allowing them to drift, the rate of retardation being noted. From the retardation curves the water friction was easily determined, and combining the results obtained in this way with the effort required to overcome the inertia of the boat, acceleration curves were obtained. This was done for empty and loaded boats, and the dimensions of the particular section of canal to which these results apply were given. From this study it was shown that it was theoretically impossible to obtain the necessary starting effort on rails without slipping, even with damp rails. It was found that a motor traveling on rails would be more economical than one running on an ordinary towpath, although the latter would give a greater tractive effort for a given weight without slipping. The system using rails will, of course, be more expensive to install, but will cost less to keep up, and, in the end, it is thought would be more economical. This study, it is believed, demonstrates the practicability of mechanical traction for canals, and seems to indicate that this will be the motive power of the future. An electrical system will be adopted, because this is reliable, efficient, and the most satisfactory method of supplying power to the motors.—*Translated and abstracted from the Revue Technique (Paris), September 25.*

# INDUSTRIAL SECTION.

*ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.*

## *Slow and Medium-Speed Direct-Current Motors.*

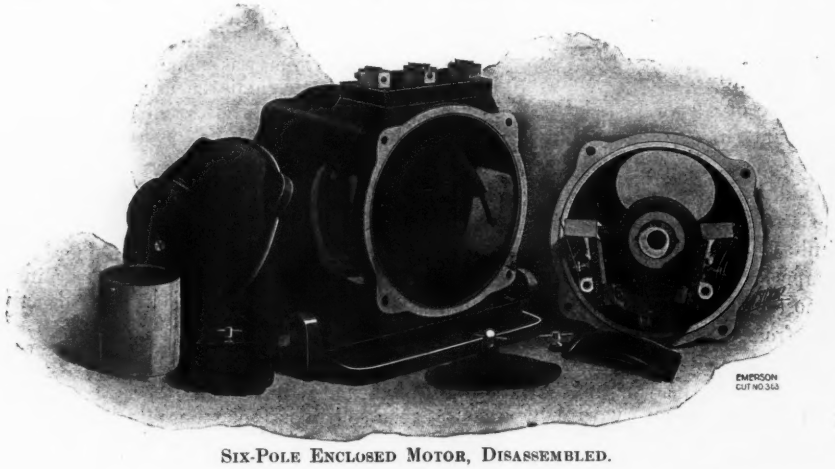
The accompanying illustrations show a typical direct-current motor for slow and medium speeds, which the Emerson Electric Manufacturing Company, St. Louis, Mo., is building for capacities from one-quarter to two horse-power. These motors are built in four sizes of frames, for both shunt and series or shunt and compound winding, and run on all standard voltages. They are the outgrowth of a line of smaller multipolar motors, a large number of which are now in service under severe and varied conditions.




SIX-POLE ENCLOSED MOTOR.

The design of these machines adapts them to any form of machine tool driving and where economy of space is a first consideration. One of the difficulties of direct-connection of motors to shop and other tools is solved by the design of the armature and commutator, which are mounted on a cast-iron sleeve, self-contained, instead of being assembled directly on the shaft. The shaft is pinned into this sleeve and may be readily removed and replaced by an extended shaft of the driven machine when desired. This arrangement eliminates all couplings and is accomplished without disturbing the relative positions of the armature and commutator.

The motors may be reversed by simply changing the connections of the armature on the binding-post plate, without removing the covers of the motor. Each plate is stamped "shunt" or "series" to indicate the winding of the motor, and also bears the word "reverse" close to the armature lead.




SIX-POLE ENCLOSED MOTOR, DISASSEMBLED.

The illustration shows a six-pole entirely enclosed motor. When ventilation is advisable the machine may be operated without covers as a semi-enclosed type. The field is composed of mild steel laminations having high magnetic qualities, and which are treated before being placed in the motor frame. The field coils are form-wound and heavily taped to prevent mechanical injury.

The armature is of the small engine type, having closed slots and no band wires. It is built of toothed laminations of mild steel, with coils dipped and baked and well insulated from each other and from the armature core.

The commutator is unusually large and is made from hard-drawn copper bars, with mica insulation.

Motors of one-quarter and one-third horse-power are fitted with three-quarter-inch steel shafts running in self-aligning phosphor-bronze bearings of the wick oil type. Larger motors are equipped with self-aligning oil-ring bearings and proportionately larger shafts. The end housings of the machines are concentric and may be moved one-quarter or one-half way round, keeping the oil wells upright if it is desired to operate the motor in an inverted or semi-inverted position.

ARMATURE FOR SIX-POLE MOTOR.

Carbon brushes of the radial type are supplied. The brush-holders are mounted on paper-insulating plates which give a long break for possible grounds likely to be caused by oil and dirt in the small enclosed motor. Owing to the design of the brush-holders, the motor may be reversed without readjusting the brushes. The rocker arm is set to the point of best commutation after test, but, if necessary, the brushes may be readjusted by loosening the thumb nut outside the cover. The brush-holder springs are of tempered steel wire, giving an even tension throughout the entire range of the brush, and are fastened directly on the fibre insulating plates holding the brush-holders. They carry no current and can not become heated from that cause.

These motors, in sizes up to one-half horse-power, are furnished with three-inch iron flanged paper pulleys for two-inch flat belt. Frames larger than one-half horse-power are equipped with crowned face iron pulleys of four-inch diameter, four-inch face.

Each motor is thoroughly tested under full rated load before shipment, and is guaranteed to operate continuously under normal load without undue temperature rise. The motors are also guaranteed to carry an overload of fifty per cent for one hour without dangerous heating.

### *Motor-Driven Machine Tools.*

The machine tool industry has witnessed a decided tendency toward the motor-drive within recent years, and the anxiety to keep abreast of improvements in this line has, no doubt, done considerable to induce the machine tool manufacturers to either make a line of motor-driven tools, or arrange their tools so that a motor can be attached, if the purchaser desires. The electric motor has come into the machine tool field to stay, and its application in this direction will increase with time. For example, take the shops power for operating all the tools in every shop. The accompanying illustrations are typical of recent practice in adapting the motor to machine tools.

Fig. 1 shows a No. 2 combination cold saw cutting-off machine, motor-driven, the machine being belted from the driving shaft to the armature shaft of motor.

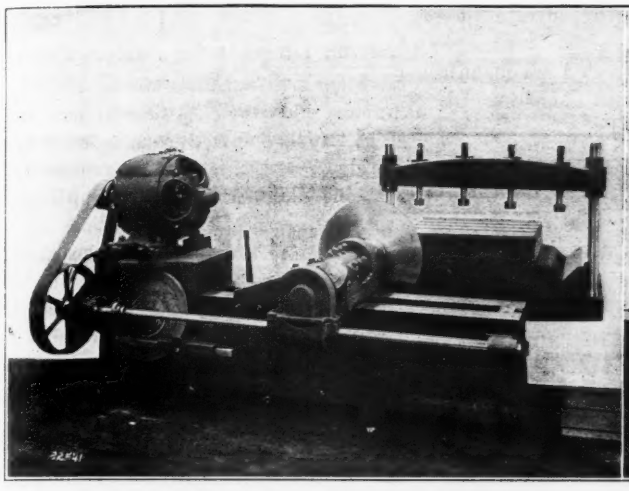


FIG. 1.—COMBINATION COLD SAW CUTTING-OFF MACHINE, MOTOR-DRIVEN.

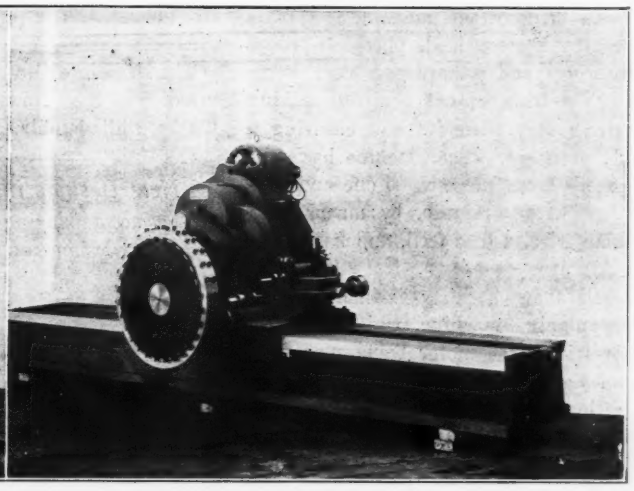


FIG. 2.—PORTABLE ROTARY PLANING MACHINE, MOTOR-DRIVEN.

This is a five-horse-power General Electric C. E. type, 250 volts, clamped to a base and has an adjustable movement which acts as a belt tightener. This machine is designed to accommodate a wide range of work, including round and square stock, to be held in V-block which clamps to the bottom table, I-beams, channel bars, etc. The machine has a capacity for I-beams and channel bars up to fifteen inches on a square or mitre cut, on bottom table up to an angle of forty-five degrees. By using the top or auxiliary table, as shown in the illustration, the machine can be used for cutting

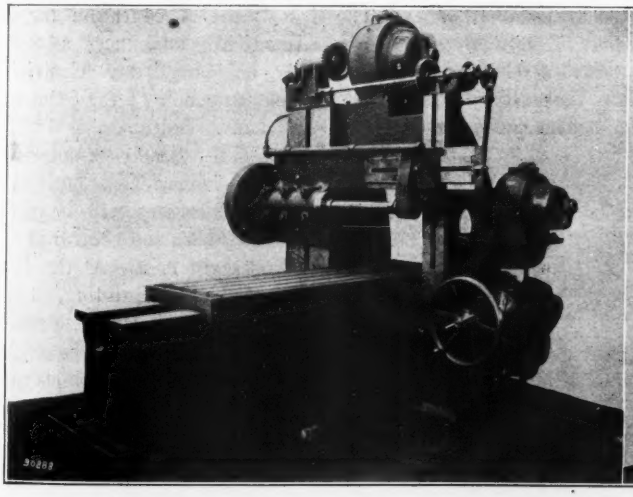


FIG. 3.—PLANE MOTOR-DRIVEN MILLING MACHINE.

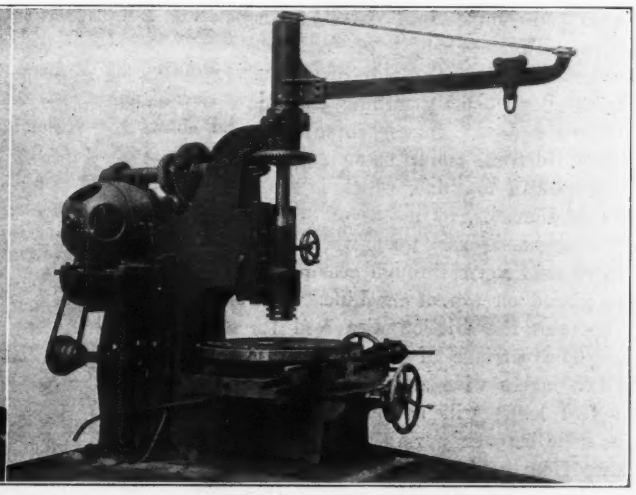


FIG. 4.—VERTICAL MOTOR-DRIVEN MILLING MACHINE.

### *New Revolving Electric Flash Light for the Lizard.*

A revolving electric flash light of 1,000,000 candle-power is to be substituted for the two present fixed lights at the famous Lizard head lighthouse, at a cost of over $15,000. It is reported from London that the new light will be visible at sea for forty to fifty miles.

which the government is having erected at New Orleans, La. According to the plans and specifications prepared under the auspices of the Bureau of Yards and Docks, Washington, D. C., the only steam that will be employed for running various machines, no matter how intricate or cumbersome, will be produced for the sole and exclusive use of generating electric

plates seven inches thick by twenty-four inches long, or an aggregate number of tee rails up to the capacity of the machine can be cut by clamping them on the top table. By removing the top or auxiliary table, the machine can be used for sawing a number of irregular pieces of work, such as gates or risers on steel castings, up to the capacity of the machine. The saw blade of this machine is spindle driven, by a steep lead, phosphor-bronze worm-wheel and a hardened steel worm through a train of cut gearing, making the drive very powerful and ensuring a steady even cut. The machine has suitable feeds from one inch to one and one-half inches per minute, by means of a variable friction disc feed, and has power quick return.

Fig. 2 shows a thirty-six-inch portable rotary planing machine, which is direct motor-driven, the motor being placed on top of the machine, as shown in the illustration, and driving a spindle through a train of cut gearing. The cutter-head, which is thirty-six inches in diameter over tools, has an in-and-out adjustment of four and one-quarter inches. The length of feed of the standard machine is eight feet. This type of machine is used principally on the housings of marine and stationary engines and for a similar class of work, where there are plain surfaces to be milled off, the work being clamped to a large floor plate and the different portable tools being brought forward to the work and clamped into position. The head has suitable changes of feed and power quick movement in both directions.

Fig. 3 shows a plain milling machine of modern design. This machine is direct motor-driven, power being supplied to a spindle of machine, which is seven inches in diameter, by means of a steep lead, phosphor-bronze worm-wheel and hardened steel worm through gearing, by motor placed on top of machine, which also operates the friction disc feed for table. The carriage of the machine is forty-two inches wide and made to mill eight feet long; will admit work fifty inches wide between uprights; maximum distance from centre of spindle to carriage of fifty inches. The small motor shown on side of machine is used for raising or lowering the cross-head by power, and also power quick movements to carriage.

Fig. 4 shows a vertical milling machine, motor-driven. The motor sets at right angles to the driving shaft, to which it is geared by means of a spiral gear and pinion which supplies the power to the spindle. When the machine is driven by a constant-speed motor the changes of speed of spindle are made mechanically, and by field control when a variable speed motor is used. The machine has a compound work table which has automatic feed in all directions. The circular carriage is forty-eight inches over tee slots, fifty-four inches over all, has an in-and-out adjustment of thirty-six inches and a cross adjustment of thirty-six inches.

The machines illustrated are manufactured by the Newton Machine Tool Works, Philadelphia, Pa.

### *New Designs in Desk Lamps.*

The accompanying illustrations show two new designs of desk lamps manufactured by McLeod, Ward & Company, 27 Thames street, New York city. Fig. 1 shows the Kinsman bookkeeper's desk lamp, which is arranged so as to clamp on the gallery of a bookkeeper's desk. This lamp is adjustable in every way, keeps the light out of the eyes, throwing it on the work. The lamp and stand are finished in nickel-plate, polished brass, old brass or oxidized copper. Fig. 2 shows the Ward typewriter's desk lamp. This stands on the desk, as shown, and can be adjusted to throw its light wherever desired. This lamp and stand are finished in nickel-plate, polished brass, old brass, or oxidized copper.

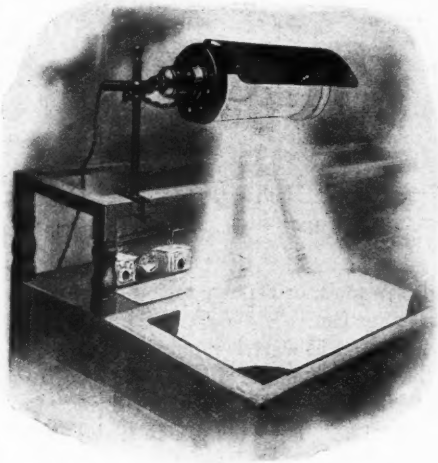


FIG. 1.—ADJUSTABLE BOOKKEEPER'S DESK LAMP.

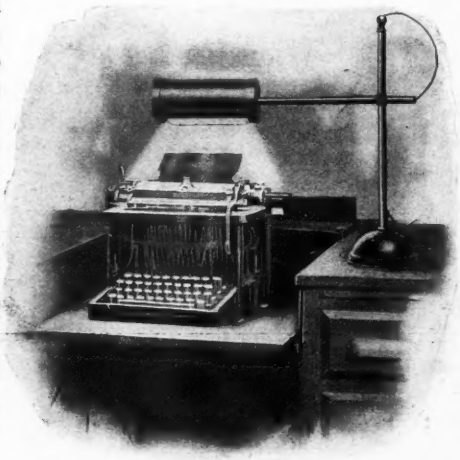


FIG. 2.—ADJUSTABLE TYPEWRITER'S DESK LAMP.

### *Steam Turbines for Factory Driving.*

The Westinghouse steam turbine is rapidly increasing its field of usefulness. The Eaton, Cole & Burnham Company, of Bridgeport, Ct., is preparing plans for a turbine plant which will furnish power to its works. Large extensions to the present work are now under way and the entire plant will then be operated by polyphase motors from the new power station. A 400-kilowatt Westinghouse turbine unit will be immediately installed to provide additional power during the construction work. It will temporarily be installed in the present power-house and will operate under 200 pounds steam pressure and twenty-eight-inch vacuum without superheat. The unit will furnish three-phase current at 440 volts. The installation is in charge of Mr. George Hooper, engineer, 11 Broadway, New York city.

### *Free Lectures Under the Department of Education for the City of New York.*

The department of education for the city of New York announces a course of lectures on chemistry, electricity, physics and astronomy for October, November and December, at the Y. M. H. A. Hall, Ninety-second street and Lexington avenue, New York city. A course of ten lectures will be given by Professor E. R. von Nardroff on Wednesdays, at eight P. M. At the John M. Toucey Memorial Building, 150th street, near Mott avenue, Bronx, a course of eleven lectures will be delivered by Mr. W. W. Kerr, on "Principles and Practice in Electrical Engineering."

### *An Electric Fan to Be Attached to a Lamp Socket.*

A German firm, Messrs. Reiss & Klemm, of No. 18 Stallschriber Strasse, Berlin, has introduced a novel electric fan which is operated from the ordinary 110-volt incandescent lamp socket. The fan is eighteen centimetres in diameter. The apparatus, with the fan cord and fan, which are all adjustable, is packed in a small carton 75 by 65 by 188 millimetres in dimension.

### *The Annual Report of the Western Union Telegraph Company.*

The annual report of the president of the Western Union Telegraph Company, Colonel Robert C. Clowry, made at the meeting of the stockholders, October 14, 1903, shows an excellent condition. The capital stock outstanding remains unchanged, namely, $97,370,000, of which $29,495.86 belongs to and is in the treasury of the company.

The revenues for the year ended June 30, 1903, were $29,167,686.80, making an increase of $1,094,591.70. The expenses for the year were $20,953,215.07, an increase of $172,448.86, making the net increase $922,142.84. After interest on bonds and appropriations for dividends have been figured, this leaves a surplus for the year of $2,268,721.73. This surplus, together with the surplus on July 1, 1902, makes a total surplus on June 30, 1903, of $13,019,724.55.

There were added to the company's system during the year 402 miles of poles and 59,228 miles of wires.

Of the newly constructed wires 47,000 miles were of copper.

The number of messages transmitted by the employés of the company was 69,790,866, being 415,983 more than for the previous year. These figures do not include the messages transmitted by the lessees of wire, nor do they include the messages of the various railroad companies that are sent between their local stations under its contracts. The uses of the leased wires were probably the equivalent of 10,000,000 messages for the year.

There was an increase of $1,094,591.70 in the revenues for the year. Of this amount the transmission of regular commercial messages contributed $321,759.90, and leased wires $282,774.28, the remainder coming from sundry other sources.

The increase in the operating and general expenses, including taxes, was $250,598.55, and for equipment of offices and wires $81,921.69. Reductions of $159,242.96 in the cost of maintenance and reconstruction, and $828.42 in rentals of leased lines, made the net increase in expenses $172,448.86.

$1,077,700 was disbursed for interest on bonds, leaving $7,136,771.73 as the profits for the year.

After paying $4,868,050 for dividends on the capital stock, $2,268,721.73 was added to the surplus account.

The average receipts per message transmitted by the company were 31.4 cents, and the average cost was 25.6 cents.

The cost of construction for the year was $3,351,644.94.

Since Colonel Clowry's last report the reorganization of the service has been completed. The system of thorough inspection, including the Atlantic and Cuba cable terminals, has been continued, and a further reduction of expenses has been effected, bringing the total saving up to $612,000 per annum.

### *Refuse Destructors.*

At the recent meeting of the British Association for the Advancement of Science, held at Southport, England, Mr. W. F. Goodrich contributed a discussion entitled "Twenty-five Years' Progress in Final and Sanitary Refuse Disposal." The author especially emphasized the necessity for high temperature of furnace in order to destroy the refuse effectively and without nuisance. The older types of destructors were practically useless by reason of the low working temperature. Figures were given showing that in 1887 the old beehive destructor at Nelson had a temperature of 705 degrees Fahrenheit, while last year the destructor installed at Walker-on-Tyne had a temperature of 3,000 degrees Fahrenheit. To-day there is at Nelson a destructor working at a temperature of 2,693 degrees Fahrenheit, and the result is that power is available for electric light and traction, about forty Board of Trade units being obtained by the burning of each ton of refuse.

At present there are 180 towns which destroy their refuse by cremation. In sixty-three of these the destructors are combined with electricity works. In forty towns they are operated in conjunction with sewage works. Five years ago there were but two destructors operated in combination with electricity works. In Liverpool destructors are being erected which are arranged to supply power for electric traction. Other instances of this arrangement are Nottingham, Wolverhampton and Preston.

### *Regular Meeting of the American Institute of Electrical Engineers.*

The following programme was announced for the regular meeting of the American Institute of Electrical Engineers, October 23, held at Carnegie Hall, 154 West Fifty-seventh street, New York city: "The Conditions Governing the Rise of Temperature of Electric Railway Motors in Service," Dr. Cary T. Hutchinson; "A Graphic Recording Ammeter and Voltmeter," by A. H. Armstrong.

### *Electric Car Equipment.*

TO THE EDITOR OF THE ELECTRICAL REVIEW:

I write to express my appreciation of the editorial in your issue of September 26 upon "The Equipment of an Electric Car." Articles of this character, explaining to the public just what may be dangerous, and what is not dangerous in the equipment of an electric car, are of great and positive value at this time. In my opinion, there is more to be feared from panic that may be caused from misinformation based upon sensational statements of newspapers than from any actual danger in the operation of properly equipped cars.

L. B. STILLWELL, Electrical Director,
Interborough Rapid Transit Company.
New York, October 13, 1903.

### *Experiments for Lessening Noise on Elevated Railways.*

Some interesting experiments are in course of prosecution on the Berlin (Germany) elevated electric railway. Complaints have been frequent concerning the noise made by the cars on the elevated structure. The first experiment consisted of inserting three layers of felt between the rails and the wooden crossties on which they were laid. This was inadequate, however, although it gave some improvement. Hollow iron girders filled with loose sand were then substituted for the wooden sleepers. This was also partially effective, but not entirely so. The rails were then laid on long longitudinal sleepers with cushions of lead under them. Finally, the car wheels have been lined with wood, so as to break the continuity of the path for vibrations through the metal. The experimental remedies are still on trial, and no definite conclusions have been announced.

McCaghey & Linehan, of Little Falls, N. Y., who have the contract for erecting the dam for the Greenfield, Mass., Electric Light and Power Company at the Gardner falls, a short distance below Shelburne Falls, are making good progress. The dam, which is about 350 feet in length, is of concrete, and rests on a rock foundation, much of the way the solid rock being cut out to make room for the dam. A canal some 1,100 or 1,200 feet in length is being built, part of the way through the rock. At the power station 1,100 horse-power will be developed. The contractors hope to finish the work by the first of November.

# CURRENT ELECTRICAL NEWS

## *DOMESTIC AND EXPORT.*

INDIANA TOLL LINE—Work has begun on the new telephone toll line which is to connect Abilene, Kan., with Indianapolis, Ind. The company building the line is composed of the owners of the exchanges at Abilene, Manhattan, Junction City, Concordia and Indianapolis, and, it is stated, has a capital of $150,000. Work has been begun at several points on the line.

RUSSIAN ELECTRIC RAILWAY—The announcement is made that a syndicate of American capitalists has under way a proposition to construct an electric line between Warsaw, the capital of Poland, and Lodz, the principal commercial centre. The length of the road will be about seventy-five miles, and it is to run in as nearly a straight line as practicable between the two points. High-speed cars will be employed, and at all points where the new line will cross other railroads viaducts will be constructed.

ANOTHER LONG-DISTANCE TROLLEY SYSTEM FOR THE PACIFIC COAST—Articles of incorporation have been filed by the Fresno Traction Company, with a capital stock of $5,000,000, to construct four electric roads from Fresno to the adjacent country with a view to opening up that territory. The total length, it is stated, will be 196 miles. The incorporators are given as W. G. Kerkoff, A. C. Balch, H. P. Baumgartner and W. D. Durfey, of Los Angeles, and A. G. Wishon, of Fresno, Cal. Mr. H. E. Huntington, who has already been prominently identified with electric railway and power enterprises in California, is said to be interested in the proposition.

A NEW ELECTRIC RAILWAY PROJECT FOR RUSSIA—An electric railway is to be constructed between the city of Kief and the borough of Brovari, the province of Thshernigof, with a branch at the village of Darnitza. A syndicate has been formed to build and operate the road, which will be of standard gauge. The principal man interested in the scheme is N. U. Matvieisf, the Kief capitalist. In order to supply current for the line, generating stations will be built at Kief and Brovari. The length of the main line will be about eighteen miles. The branch line will be five miles long. According to the agreement entered into with the Russian Government, the road is to be in operation within two years.

WATER POWER PLANT AT SHERBROOKE, QUEBEC—The city council of Sherbrooke, Quebec, has appointed a commission to report upon the development of water power at Westbury basin, situated about eighteen miles from the city. The minimum flow of water is 40,000 cubic feet per minute, and the available head is thirty-seven feet. The council recommends dividing the power plant into three units, providing room for a fourth unit, to be installed when the minimum flow is increased. Each power unit is to consist of a three-phase sixty-cycle 500-kilowatt generator running at about 425 revolutions per minute and driven by two pair of turbines on a horizontal shaft direct-coupled to the generator. Reports show that for a development of 2,500 horse-power the cost is placed at $207,226, made up of $19,000 for hydraulic machinery, $42,800 for power station electrical equipment, $18,000 for substation, $87,550 for dams and work apart from machinery and lines, and the balance for contingencies, engineering and superintendence. A second estimate is $188,526, and covers power-house and other works for four units, only three of which are to be installed at present. The power developed in this case would be 1,875 horse-power.

EXTENDING ELECTRIC TRAFFIC ARRANGEMENTS IN NEW JERSEY—Traffic agreements between various electric railway companies operating in New Jersey have made possible the running of through cars from Camden to Jersey City. This service, it is stated, will be introduced on November 15, on a schedule of six hours for the entire trip. The Trenton & New Brunswick Railway Company will inaugurate the new service, operating over the Camden & Trenton Railway to Trenton, over its own line from Trenton to New Brunswick, and from New Brunswick by way of the Middlesex & Somerset Traction Company's and Public Service Corporation's tracks to Jersey City. Since the tracks of the Public Service Corporation were connected with those of the Middlesex & Somerset Traction Company at Dunellen, the only gap in the electric railway chain between New York and Philadelphia is four miles of track yet to be constructed on the Camden & Trenton Railway. It is announced that this will be completed in time to establish through service before the middle of November. Although the officers of the Trenton & New Brunswick Railway Company have entered into a temporary agreement with other companies, it is expected that it will complete its own line from Trenton to Elizabeth and reduce the time to four hours between Philadelphia and New York within a year.

THE CANADIAN WESTINGHOUSE COMPANY—As announced last week, the Canadian Westinghouse Company, Limited, was organized at Hamilton, Ontario, October 8, 1903. The capital is $2,500,000. The new company is a consolidation of all the Westinghouse interests in Canada, which heretofore have been conducted individually. It will take over all the property, patents and other interests of the succeeded companies, including the sales organization and business of Ahearn & Soper, of Ottawa. The organization committee elected the following board of directors: Mr. George Westinghouse, Pittsburg; C. F. Size, of Montreal; H. H. Westinghouse, George C. Smith, Frank H. Taylor, L. A. Osborne, all of Pittsburg; Thomas Ahearn, of Ottawa; the Hon. J. M. Gibson, of Hamilton, W. Y. Soper, of Ottawa; Paul J. Myler, of Hamilton. The executive committee will consist of the following gentlemen: Mr. H. H. Westinghouse, Mr. F. H. Taylor, Mr. L. A. Osborne, Mr. George C. Smith and Mr. W. Y. Soper. The officers are as follows: Mr. George Westinghouse, president; Mr. H. H. Westinghouse, vice-president; Mr. F. H. Taylor, vice-president; Mr. Paul J. Myler, general manager and treasurer; Mr. John H. Kerr, secretary. While only ten directors were elected, the board, when complete, will consist of fifteen members, the remaining five to be named from among the Canadian gentlemen interested. Ground is to be broken for the new works at Hamilton within a week, and the erection of the new buildings will follow as fast as possible. It is expected that at least 1,000 employés will be serving the company within a year.

ELECTRICAL INDUSTRIES OF GERMANY—Mr. S. W. Hanauer, deputy consul-general at Frankfort, Germany, writes, under date of August 25, that Dr. Bürner, the syndic of the Association for Guarding the Interest of German Electrotechnics, makes several valuable statements in a brochure recently published by him. In 1900 about $595,000,000 was invested in the electrical industries of Germany. The severe crisis which it has undergone, and from which it still suffers, is, in the main, due to the following causes: The electrical companies, instead of confining their activity to manufacturing, engaged in promoting ventures and obtaining concessions, and carried on the building of electric roads, lighting plants, etc., in towns and rural districts, instead of leaving these enterprises to the municipalities, financial promoters and private companies. A great mistake was committed in erecting and conducting branch electrical factories in other countries, which caused numerous competitors to spring up in those countries and led other German companies to enter the foreign business, thereby producing a sharp struggle to obtain profitable orders. A third error was the practice inaugurated by the electrical companies of establishing installation shops in all the cities and large towns of Germany, instead of leaving that part of the business to the resident plumbers and installation concerns. Dr. Bürner does not favor the plan of uniting the German electrical companies into one common concern. He urges the formation of syndicates to regulate and protect prices and limit production where such is unprofitable. The main recommendation is to extend and increase the export trade. During 1902 Germany exported 13,499 tons of electrical machinery, 8,481 tons of electric cable, 2,295 tons of carbon burners, and 2,206 tons of accumulators.

### *PERSONAL MENTION.*

PROFESSOR ARTHUR E. KENNELLY, professor of electrical engineering in Harvard University, and president of the Society for the Promotion of the Metric System, was recently in Canada spending a holiday.

MR. HERBERT F. MOORE has tendered his resignation as instructor in machine design at Cornell University to accept a position as mechanical engineer at Riehle Brothers Testing Machine Company, Philadelphia, Pa.

MR. JOHN GRAHAM MILLAR, manager of the roofing department of the H. W. Johns-Manville Company, died at St. Luke's Hospital, New York city, on October 15. Mr. Millar was forty-two years of age and was well known throughout the electrical and allied industries.

MR. R. S. KELSCH, E. E., of Montreal, has submitted to the city council of Ottawa a report on the establishment of an electric plant for street lighting, the present contract with the Ottawa Electric Company expiring May next. The complete plant could be secured for $40,000. The cost of operating is estimated at $19,900 a year.

MR. HERBERT LLOYD, president of the Electric Storage Battery Company, Philadelphia, Pa., has returned from a two months' tour of London, Berlin, Paris and other European capitals. Mr. Lloyd spent some time in London, where his company has large interests, and where it is associated with the Chloride Electrical Storage Syndicate, Limited.

MR. DERMOT McEVOY, late engineer for the Gutta-Percha and Rubber Manufacturing Company, of Toronto, and recently with the Fairbanks Company, has been appointed engineer and mechanical superintendent of the Canadian Rubber Company, Montreal, whose works are now being remodeled and equipped with new machinery at a cost of about $150,000.

SIR CHARLES METCALFE, the builder of the section of railroad that will touch on Victoria Falls and Bulawayo, Africa, and Mr. I. F. Jones, manager of the South African Charter Company, which has the concession for opening up that part of Africa, arrived last week on the Campania. They will spend a month, it is said, visiting Niagara Falls and the various centres of industry, to learn whatever may be of advantage in the construction of the power-house at Victoria Falls.

PROFESSOR E. W. RUTHERFORD, whose investigations into the properties of radium have been so much discussed, and who was recently elected a fellow of the Royal Society, has returned from Great Britain to take up his duties at McGill University. Mr. F. Soddy, of McGill University, who was a coinvestigator into radium with Professor Rutherford, and who went to England this summer, will not return to Canada, having accepted a post in Owen's College, Manchester, England.

PROFESSOR W. J. SWEETSER, B. S., of Newton, Mass., has recently been appointed to the chair of engineering in Mt. Allison University, Sackville, New Brunswick. Professor Sweetser graduated from the Massachusetts Institute of Technology in 1901, and was considered such a brilliant student that he was offered an assistant professorship in that institution. Since graduation he has been employed in engineering work. Professor Sweetser will have charge of the McClellan School of Industrial Arts, and will organize a manual training course in connection with the Sackville High School.

MR. LOUIS SIMPSON, consulting engineer, of Ottawa, Ontario, has recently visited the United States for the purpose of investigating the merits of the different electrical furnaces. He is confident that the electrical reduction of iron ores, and their conversion into steel, is a commercial possibility under the conditions which exist in the Ottawa valley and near the city of Ottawa. The difficulty seems to be only in the collection of sufficient data in order to decide which of the several different furnaces and processes are the best to adopt. Mr. Simpson is continuing his investigations with a view of utilizing some of the water power at the Chats falls, within twenty miles of the city of Ottawa, for the purpose of producing iron and steel.

DR. LEE DE FOREST sailed October 14 on the White Star steamer Majestic for England, taking with him his chief assistant, H. M. Horton, and two outfits of the De Forest wireless telegraph apparatus, at the request of prominent men connected with the British Post Office, the Admiralty and others. A demonstration is to be made between Holyhead and Dublin, and all the facilities of the Post Office have been put at Dr. De Forest's disposal toward this end. Sir William Preece is especially interested in the enterprise. The matter of speed of transmission of the De Forest system will be especially observed. It is the intention of those interested in Great Britain to incorporate the British Empire De Forest Company upon the completion of these tests.

S. W. CHILDS.

MR. S. W. CHILDS has just returned to this country after an absence of several years in West Australia, where he was until his departure general manager of the Kalgoorlie electric tramways. Mr. Childs started in the electric railway business on the old Watervliet Turnpike Railway, at Albany, N. Y. In 1890 he went to Boston, remaining in the employ of the old West End Street Railway Company for two years, when he went to Lincoln, Neb., where he was engaged in construction work. In 1892 he was employed with the Atlantic Avenue Railroad Company in Brooklyn, N. Y., under the late Deacon Richardson. Leaving Brooklyn, Mr. Childs entered the employ of J. G. White & Company, and was assigned to Baltimore, Md., where he had charge of track and overhead construction work. From Baltimore he went to Columbus, Ohio, becoming superintendent for the Columbus Central Railway Company, for which company he laid out the entire track, overhead and pleasure park system. In 1896 he left Columbus to take charge of the construction work at Fort Wayne for the Degnon Construction Company, going to Charleston, S. C., in 1898, in charge of the construction

work on the electric railways of that city. He went to Australia for the first time in the fall of 1898, as assistant engineer for J. G. White & Company, in connection with the electric tramways at Perth, West Australia. In 1901 he returned to America and was placed in charge of the construction for the Toledo & Monroe Electric Railway. He left this position to return to Australia as manager of the Kalgoorlie electric tramways. On his recent return trip to America Mr. Childs made an extensive tour of New Zealand and the Philippine Islands, as well as several cities in China and Japan where electric railways are contemplated or are being built. Before leaving Kalgoorlie Mr. Childs was tendered a banquet by the citizens, and an engrossed testimonial of which the above is a reproduction.

### ELECTRIC LIGHTING.

MERIDEN, CT.—The board of public works has entered into a five-year contract with the Meriden Electric Light Company.

DETROIT, MICH.—Contract in part for construction of generating plant of the Edison Illuminating Company has been let.

HUNTINGTON, L. I.—The Huntington town board has contracted with the Huntington Light and Power Company for street lights.

LOGANSPORT, IND.—It has been reported that $25,000 will be expended the coming year for additional power for the electric light plant.

MT. MORRIS, N. Y.—It is stated that Herbert Wadsworth will install an electric light system at Ashantee, to cost in the neighborhood of $5,000.

BRISTOL, VA.—It is announced that the Bristol Gas and Electric Company will expend a quarter of a million dollars in extending its lighting plant.

WAUTOMA, WIS.—At a recent meeting it was almost unanimously voted to bond the village for a sum sufficient to erect an electric lighting plant.

BARNESVILLE, GA.—The Stanley Electric Manufacturing Company, Pittsfield, Mass., has secured the contract for a $6,000 municipal electric light plant.

WILLIAMSBURG, OHIO—It is reported that the board of public service asked for bids until October 1 for an electric light plant, including engine, generator, switchboard and other material.

PALOUSE, WASH.—The Potlatch Lumber Company has finished the work of installing its electric lighting plant, and its yards and shops are now lighted with both arc and incandescent lamps.

HAZLETON, PA.—City councils in joint session have awarded a five-year contract to the Hazleton Electric Light Company and the Welsbach Lighting Company for illuminating the streets of the city. The contract calls for 100 or more arc lights at $70 each per annum.

ALHAMBRA, CAL.—At the request of the Pacific Light and Power Company, the city trustees have advertised for sale a franchise for the introduction and operation of an electric light and power system in Alhambra, to cover a period of fifty years. It is probable that the company will be the only bidder.

GREENFIELD, MASS.—Work is progressing rapidly on the new dam of the Greenfield Electric Light and Power Company at Gardner Falls, below Shelburne Falls. A large portion of the foundation is already in. The company will purchase a right of way from Greenfield to Gardner Falls for its poles.

LEWISTON, ME.—In order to meet very extensive calls for electric lighting power, the Lewiston & Auburn Electric Light Company is now planning to put in a generator of from 200 to 300 horse-power at its Lincoln Mill station. This generator will be driven from the same wheel that formerly furnished power for the Lewiston, Bath & Brunswick street railway. Its electrical equivalent will be from 2,000 to 3,000 lights.

SIOUX CITY, IOWA—The Sioux City Gas and Electric Company has completed all the improvements which it will make to its plant this year. The total cost of these improvements was $60,000, which is said to be the smallest amount the company has expended in betterments for the past ten years. The company states that next year three times this amount will be required to do the work outlined. The electric lines were practically rebuilt this year, over 1,200 new poles being set up.

BOSTON, MASS.—An order has been issued by the gas and electric light commissioners, approving the issue by the Pittsfield Electric Company of 500 shares of additional capital stock of the par value of $100 each, the proceeds to be applied for the following purposes: The proceeds of 300 shares to be applied for the payment of an equal amount of the promissory notes of the company now outstanding, and the proceeds of 200 shares to be applied for the payment of the cost of additions to the company's plant made subsequent to June 30, 1903.

### TELEPHONE AND TELEGRAPH.

WASHINGTON, N. J.—A telephone line will be built connecting Califon and Mountainville.

COLUMBIA, N. Y.—The Columbia Telephone Company is extending its lines through the southern towns of this county.

CHATTANOOGA, TENN.—The Hamilton Telephone Company has been granted a franchise over all the streets of the city.

JOHNSTOWN, PA.—The Huntington & Clearfield Telephone Company has authorized the construction of a line from Clearfield.

PORTLAND, ORE.—The Bohemia Telephone Company has elected the following directors: David Flinn, Frank Wheeler and Frank Jordan.

NUNDA, N. Y.—The directors of the Nunda Telephone Company have decided to construct a line to Dalton and another branch to Brooks Grove.

MACON, GA.—A new telephone system may be placed in Macon, A. W. Zealey and David Goldberg having petitioned council for the privilege of using its streets.

SPOKANE, WASH.—The Rocky Mountain Bell Telephone Company has drawn plans for some extensive improvements in its service in this part of the state.

JAMAICA, L. I.—The New York & New Jersey Telephone Company has bought a plot of ground, upon which it contemplates the erection of a new exchange building to cost $15,000.

CINCINNATI, OHIO—The New Baltimore & Venice Telephone and Telegraph Company has been granted permission to erect poles and string wires on the various county roads.

MIDDLETOWN, OHIO—It was learned that the United States Telephone Company had secured rights of way necessary for a trunk line over the county roads from Dayton to Hamilton.

GALLIPOLIS, OHIO—The Swan Creek Telephone Company has been organized with the following officers: J. C. Lewis, president; John Evans, vice-president; O. Hibert, secretary and treasurer.

NEWPORT NEWS, VA.—The Currituck Telephone Company, of Coinjack, Currituck County, has been chartered with $10,000 capital, authorized to construct telephone lines between the principal towns of that and adjacent counties.

CHARLOTTE, N. C.—The Manning Telephone Company has been chartered, with a capital of $5,000. The company will conduct a business in Clarendon and Williamsburg counties. W. Jenkinson is president, and D. Bradham, general manager.

NORTHVILLE, MICH.—The Northville Telephone Company held its annual meeting and elected the following officers for the ensuing year: President, Dr. J. M. Burgess; vice-president, F. S. Neal; secretary, R. H. Porter; E. L. Lapham, treasurer; M. A. Porter, manager.

BUFFALO, N. Y.—The stockholders of the Frontier Telephone Company have elected the following directors for the ensuing year: Charles W. Goodyear, E. C. Lufkin, Clark C. Ingham, William A. Douglas, Martin Carey, Fred A. Green, Henry H. Persons, James M. Thomas, H. D. Kirkover, Charles B. Hill, Alvan Markle, Samuel L. Wayland, Charles E. Austin, John B. Weber and John Markle.

CARROLLTON, GA.—Judge S. W. Harris, of the Coweta Circuit, has granted to the Gainesboro Telephone Company of this city on petition the right to increase their capital stock from $40,000 to $150,000. This corporation is a long-distance telephone company and covers this county and the counties of Haralson, Heard, Coweta, Paulding, Polk and several miles of lines in Randolph County, Alabama.

MISSOULA, MONT.—Extensive work is being done by the Rocky Mountain Bell Telephone Company in this part of the state. It is expected that the main line will be extended in the near future to Sand Point, Ida., and that while it is being constructed a new line will be run by way of the Great Northern Railway track and Newport, Wash., to Spokane. Present connections between Montana and Spokane are made by way of Wallace, Ida., but press of business requires another line. The company is now rebuilding its system at Wardner, Ida.

## ELECTRICAL SECURITIES.

The market at the close of last week evidenced a tendency on the part of capitalists to accumulate stocks. The early declines of the week were followed by a sharp rally and this has raised hopes that the declining movement and forced liquidation in these issues have ended. While the market continues to give evidence of stability, the public has become so dissatisfied and sceptical that it may be some time before it will venture to take a positive interest in industrial securities. One of the main developments of the week included the declaration of the regular quarterly dividend of the Amalgamated Copper Company. The foreign money market is easy, as is also the local money market. The possibility of war between Russia and Japan has clouded the foreign situation, but the present outlook is peaceful and indicates no immediate disturbance in that direction. All of the large electrical securities showed advances for the week, and the continued declaration of dividends and the condition of the surplus in these institutions, seem to make it certain that the advance will be continued.

| *New York:* | *Closing.* |
|---|---|
| Brooklyn Rapid Transit | 33¾ |
| Consolidated Gas | 174⅞ |
| General Electric | 148 |
| Kings County Electric | 140 |
| Manhattan Elevated | 132½ |
| Metropolitan Street Railway | 105¼ |
| New York & New Jersey Telephone | 140 |
| Westinghouse Manufacturing Company | 161 |

Brooklyn Rapid Transit earnings from July 1, 1903, to October 12, increased $470,000 over the corresponding time last year.

The balance sheet of the Kings County Electric Light and Power Company, as of June 30, 1903, shows total assets of $11,104,145 and liabilities of $10,811,842, leaving a surplus of $292,303.

| *Boston:* | *Closing.* |
|---|---|
| American Telephone and Telegraph | 123¼ |
| Edison Electric Illuminating | 230 |
| Massachusetts Electric | 77 |
| New England Telephone | 122½ |
| Western Telephone and Telegraph preferred | 79 |

The statement of the Edison Electric Illuminating Company, as of June 30, 1903, shows gross earnings of $2,667,809 and expenses of $1,683,085, leaving a net income of $984,724. Other income amounted to $32,502, giving a total income of $1,017,226. Dividends and charges were paid to the amount of $955,971, leaving a surplus of $61,255, as compared with a surplus of $116,098 for the preceding year, and a surplus of $52,393 in 1901. The board of gas and electric light commissioners has granted the company permission to issue 20,000 shares of new capital stock at $200 a share, to provide money for improvements and betterments. The company has purchased seven acres of land in South Boston, and plans for a 75,000-horse-power station have been prepared. Contracts have already been let for the first section of the new station building, and upon the completion of this section of the plant, all of the towns reached by the suburban companies recently purchased will be supplied from the Edison company's Boston station. At the annual meeting of the company, recently held, the old directors were reelected.

| *Philadelphia:* | *Closing.* |
|---|---|
| Electric Company of America | 7⅝ |
| Electric Storage Battery common | 48 |
| Electric Storage Battery preferred | 48 |
| Philadelphia Electric | 6 |
| Union Traction | 42⅞ |
| United Gas Improvement | 80 |

It is stated that the Philadelphia Electric Company, at its present rate of earnings, will show for the present fiscal year about $600,000 net profits for the stock.

It is expected that the net earnings of the United Gas Improvement Company for the fiscal year, to end December 31 next, will be close to 12 per cent on the $36,725,000 of stock. Last year they were about 12 per cent on $28,250,000 of stock, or 9 per cent on the present outstanding stock, and were an increase of about $900,000 over 1901.

| *Chicago:* | *Closing.* |
|---|---|
| Chicago Telephone | 120 |
| Chicago Edison Light | 145 |
| Metropolitan Elevated preferred | 55 |
| National Carbon common | 19½ |
| National Carbon preferred | 88½ |
| Union Traction common | 4¾ |
| Union Traction preferred | 33 |

The Chicago Telephone Company made a total gain in September of 1,603 telephones, making the total now in use 95,628.

It is claimed that the earnings of the National Carbon Company for the first eight months of 1903 will be fully equal to those of 1902, the net earnings of which were $594,371, out of which $315,000 for dividends and $254,396 for depreciation were deducted, leaving a surplus of $24,975. The total surplus shown in the last statement was $156,000.

## AUTOMOBILE NOTE.

ENDURANCE CONTEST FROM NEW YORK TO PITTSBURG—The automobile endurance contest from New York to Pittsburg, by way of Cleveland, ended in Pittsburg on October 15. The committee having the arrangements in charge planned a parade for the machines which had finished the run. The first machine in was driven by Mr. Webb Jay, arriving at 11.49 A. M. The second machine was driven by Mr. B. B. Holcomb, arriving at 12.22 A. M. The third machine was driven by P. H. Deming; the fourth by Mr. W. H. Box, and the fifth machine by Arthur Gardner. The parade was led by the car containing the local officials, J. Francis Burke, W. C. Temple, W. Linford Smith and Arthur Banker.

## LEGAL NOTES.

WRONGFULLY DISCONNECTING A TELEPHONE FOR NONPAYMENT OF RENT—The measure of damages for wrongfully disconnecting a telephone because of a mistake as to the payment of rent is held in Cumberland Telephone and Telegraph Company *vs.* Hendon (Ky.) 60 L. R. A. 849, to be the amount which will compensate the patron for the injuries caused by the breach of contract.

THE NEGLIGENCE OF A RAILROAD COMPANY—The construction of a freight platform so near a railroad track that the elbow of a passenger may come in contact with freight on the platform as the passenger is seated inside of a passing car with his elbow resting on the sill of one of the windows of the car and protruding but slightly is held, in Kird *vs.* New Orleans & N. W. R. Company (La.) 60 L. R. A. 727, to be gross negligence on the part of the railroad company, rendering it responsible in damages to a passenger injured thereby.

SUIT ENTERED AGAINST A SUBWAY COMPANY—Corporation Counsel Rives, it is announced, will institute a suit for the city of New York against the Consolidated Telegraph and Electrical Subway Company for an accounting under several agreements which this company has made with the city. The suit will be based on a report made by the commissioner of accounts after an investigation of the affairs of the defendant corporation which was ordered some time ago by Commissioner Monroe, of the department of water supply, gas and electricity. The Consolidated company's agreement with the city was to the effect that after the company had earned ten per cent on the actual cost of the subways, it would pay all excess over that amount to the city. It was also provided that in case in any year ten per cent is not earned by the company, it should be entitled to recoup itself. Another alleged agreement was that after January 1, 1897, the company should sell all the subways constructed by it to the city at actual cost of construction, plus, in case of failure to have earned ten per cent, ten per cent on the actual cost. The investigation by the commissioners of account was to determine the actual cost of the subways. The construction account stood on January 1, 1903, at $7,492,291.62. The expert of the commissioners of accounts challenges this construction cost and asserts that the corporation has violated the agreement in several ways.

## INDUSTRIAL ITEMS.

THE GLOBE ELECTRIC CONTROLLER COMPANY, Amsterdam, N. Y., has recently issued an attractive catalogue descriptive of the electric controller apparatus manufactured by it. The catalogue will be sent on request.

THE MICA INSULATOR COMPANY, New York and Chicago, has recently sent out a postal bearing interesting information in connection with the mica insulators which it manufactures. Price list and descriptive matter will be sent on request.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, in its October calendar of its great men of science and engineering series gives a portrait in colors of Sir George Biddell Airy, with the accustomed biographical sketch.

CHARLES E. DUSTIN COMPANY, 11 Broadway, New York, has just issued its "fall, 1903, bulletin." This contains a list of alternating and direct-current generators and motors, miscellaneous electric apparatus, transformers, arc dynamos and steam engines which it has for sale. This bulletin will be sent on request.

CHARLES C. MURRAY & COMPANY, engineers, 63 First street, San Francisco, Cal., have issued a booklet entitled "Steam Power Plants on the Pacific Coast." This is a handsome piece of work and gives the power rating and detail of equipment of some of the work which this company have done in the past few years on the Pacific coast and in the Hawaiian Islands.

THE KINSMAN ELECTRIC AND RAILWAY SUPPLY COMPANY, 91 Liberty street, New York city, is the manufacturer of a high-grade automobile cable for which there is a steady demand. This cable is extremely flexible and is so covered with braiding and tape that it is absolutely protected from oil, which is so injurious to the rubber covering of spark coil wire.

THE CUTTER COMPANY, Nineteenth and Hamilton streets, Philadelphia, Pa., is sending out an attractive postal advertising the "I. T. E." circuit-breaker. This circuit-breaker affords automatic and instantaneous protection to motors and generators. It is made in all sizes and for every variety of installation. The company will be pleased to send complete catalogues upon request.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., is distributing several new bulletins descriptive of direct-current power motors of slow, medium and high speeds, from one-sixteenth to one-eighth horse-power; direct-current motors for slow and medium speeds, from one-quarter to two horse-power, and polishing and grinding motors for alternating currents and direct currents, with chucks mounted on motor shafts.

THE NERNST LAMP COMPANY, Pittsburg, Pa., has issued a valuable treatise on the Nernst lamp by Mr. A. J. Wurts, the electrical engineer who has developed the Nernst lamp to its present practical efficiency. This is a text-book of the highest character and will prove of value to not only the electrical profession, but also to students of electrical science. In addition to the great practical value of the book, the typography and illustrations are excellent in treatment and design.

THE NEWTON MACHINE TOOL WORKS, Philadelphia, Pa., has published a new catalogue, No. 36, descriptive of the engineering specialties in metal-working machinery manufactured at its works at Vine, Twenty-third, Twenty-fourth and Pearl streets, Philadelphia, Pa. This company, in addition to its line of straight machine tools, manufactures a complete line of electrically driven tools of every design. The company will be pleased to receive specifications or requests for this catalogue.

THE EWING-MERKLE ELECTRIC COMPANY, St. Louis, Mo., is the general selling agent for the Bryan-Marsh Imperial incandescent lamp, which was described in a recent number of the ELECTRICAL REVIEW. These new Imperial lamps burn out before they burn dim; that is, these lamps run along for 500 hours at about ninety per cent of the initial candle-power. After the 800 hours, they cross the eighty per cent line and a few hours later burn out. Full information will be sent upon request of the company.

THE PHELPS COMPANY, Detroit, Mich., manufacturer of the Hylo incandescent lamps, through its secretary, W. J. Phelps, writes, in his unique fashion: "It may interest you to know that business in the old reliable 'turn-bulb Hylo lamp' for September was fifty per cent in excess of September last year. It does not look as though that lamp was being sidetracked. It has even more friends than we realized until we began pushing our other new things. If our lamps were only a little more self-making, as well as self-flashing, we could get reckless in publicity."

THE NATIONAL BATTERY FAN COMPANY, 14 South Broad street, Philadelphia, Pa., announces that it has developed a new form of storage battery combining the principles of primary and secondary batteries. The advantages of each type have been retained, so that it may be recharged at a nominal cost, and producing a dry battery capable of being shipped like ordinary merchandise to any part of the country. The advantage of this battery will be the furnishing of electric power to fans and other small machines at isolated points where live current is not available.

THE H. W. JOHNS-MANVILLE COMPANY, 100 William street, New York city, will be pleased to send to any one interested, upon request, a folder describing the Prairie Fire drag, a device for extinguishing prairie fires. The drag consists of a chain mat covered with an asbestos smothering blanket supplied with chains at two corners, and which may be easily and quickly adjusted to drag by the horn of the saddle or by a single tree. A reproduction of a wash drawing by the well-known illustrator, Mabie, shows two mounted cowboys putting out a prairie fire with the drag.

MESSRS. WURMB & BAUMANN, 502 Holland Building, St. Louis, Mo., have developed a new form of electromagnet for which patent No. 682,377 has been granted. The features claimed for this electromagnet are economy of construction, economy of current, and long distance of throw. The electromagnet is made by pivoting the armature directly on the pole end of one of the cores, closing the air-gap at this pole of the electromagnet entirely. In normal position, when the armature is slightly open, it is slightly overbalanced by means of an adjustable balancing weight or by any suitable adjustable spring. When the circuit is opened the spring pin gives the armature the impulse for quick return action.

THE STANDARD WELDING COMPANY, Cleveland, Ohio, will be pleased to send its new catalogue descriptive of electrically welded steel tubing, rims, bicycle parts, etc., to any one interested. This company manufactures seamless steel tubing of all kinds, seamless rims for all types of wheels and tires, Standard clincher rims for wood and wire wheels, and all forms of bicycle tubing. The new catalogue contains, in addition to a description and illustrations of the manufactured products of this company, the normal weight in pounds per foot of Standard seamless steel tubing, decimal equivalents of an inch, and a question sheet from which to select the material best adapted for the purpose intended.

THE CARBORUNDUM COMPANY, Niagara Falls, N. Y., has recently published its catalogue No. 4, descriptive of carborundum manufactured under the Acheson patents. The frontispiece shows the development of the works since 1893, giving comparative pictures of the factory as it existed then and the present plant. The catalogue contains an illustrated reprint of a lecture delivered before the Franklin Institute by Francis A. J. Fitzgerald, entitled "The Manufacture and Development of Carborundum at Niagara Falls." In addition to this there are chapters on "The Characteristics of Carbide of Silicon in the Manufacture of Iron and Steel;" "The Characteristics of Carborundum;" "Carborundum Wheels," together with illustrations and sizes of the special wheels made by this company and a description of other specialties such as carborundum sticks, knife sharpeners, razor hones, sharpening sticks, oil sticks, etc.

THE PERKINS ELECTRIC SWITCH MANUFACTURING COMPANY, Bridgport, Ct., is mailing its new catalogue descriptive of its specialties. The catalogue contains 192 pages and is six and one-half by three and three-quarters inches in dimension, with rounded corners. This makes it a convenient pocket size. The cover is dark green buckram. The front cover design shows a nickel-plated flush-plate with two rotary flush switches. The back cover design is the Perkins key socket with shade-holder rigidly attached to the shell. This is one of the new goods shown for the first time in this catalogue. The catalogue lists 1,200 articles, each article having an individual catalogue number and telegraph code word. The illustrations throughout are in half-tone, and these are especially well done, particularly those of articles made up of porcelain. This catalogue is not being distributed direct to the consumer, but enquiries may be sent to any electrical supply house in the country.